DEGRADATION AFTER USING THE NCAT ASPHALT CONTENT TESTER

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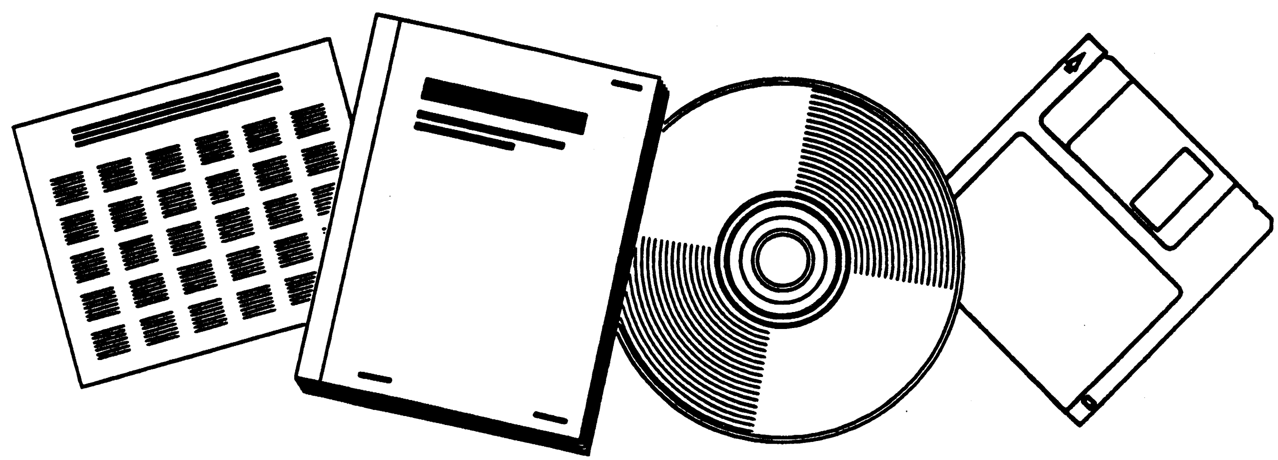

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DETERMINING the DEGREE of AGGREGATE DEGRADATION After Using the NCAT ASPHALT CONTENT TESTER.

Randolph Reyes

Colorado Department of Transportation
4201 East Arkansas Avenue
Denver, Colorado 80222

Final Report
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Colorado Department of Transportation
4201 E. Arkansas Ave.
Denver, Colorado 80222

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13. ABSTRACT (Maximum 200 words)

The purpose of the research conducted was to determine if aggregate degradation takes place and to measure the possible degree of degradation after bituminous mixtures are heated inside the NCAT Asphalt Content Tester. A study was conducted which compared the orginal aggregate blend (Control specimens) to the residual aggregate blend (Experimental specimens) obtained after several bituminous mixtures were heated inside the NCAT Asphalt Content Tester. The Control specimens and the Experimental specimens used to produce the bituminous mixtures were the result of an aggregate sample which was split three times. Two methods of analysis were used to review the gradation results. It was determined after reviewing both methods of analysis, that the gradations of the bituminous mixtures used in the study were not statistically different after being heated inside the NCAT Asphalt Content Tester. The aggregate gradation correction factors that were required in this study were relatively low (less than one percent) and were needed only in a few instances. However, this might not be true in all instances.

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The contents of this report reflect the views of the author who is responsible for the facts and the accuracy of the data presented herein. The contents do not necessarily reflect the official views of the Colorado Department of Transportation or the Federal Highway Administration. This report does not constitute a standard, specification, or regulation.

The author would like to express his gratitude to the CDOT Research Panel which provided many excellent comments and suggestions for this study; it included Donna Harmelink (CDOT Research), Robert LaForce (CDOT Flexible Pavement), Tim Aschenbrener (CDOT Staff Materials), Ken Wood (CDOT Region 4 Materials), Cindy Price (Region 1 Materials), R.J. Hinojosa (Region 6 Materials), Chuck McGarvey (Region 2 Materials), Charlie MacKean (CDOT Staff Materials) and Paul Macklin (CDOT Geotechnical Section).

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ANALYSIS METHOD ONE

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1.0 INTRODUCTION

The United States Environmental Protection Agency (EPA) is phasing out chlorinated solvents used in the United States. These solvents have been used in the past to remove the asphalt cement (AC) from bituminous mixtures allowing aggregate gradations to be performed. The NCAT Asphalt Content Tester (an ignition oven) has been introduced as an alternative to the solvent extraction method. It works by removing (physically burning away) the AC from the bituminous mixture.

Several companies manufacture ignition ovens, including Barnstead/Thermolyne, Troxler, and Gilson Corporation. The Barnstead/Thermolyne equipment is known as the National Center for Asphalt Technology (NCAT) Asphalt Content Tester and was used to generate the data in this paper. The ignition oven and the NCAT Asphalt Content Tester refer to the same equipment in this document.

1.1 Background

In June of 1995, the Colorado Department of Transportation purchased and received six NCAT Asphalt Content Testers manufactured by Barnstead/Thermolyne Corporation. The Central Laboratory located in

Denver, Colorado retained two of the ovens and distributed the remaining four ovens to different Regions throughout Colorado. One oven in the Central Laboratory was set up (electrically wired and vented) for use. The NCAT Asphalt Content Tester was then evaluated concerning its effect on aggregate gradations from different bituminous mixtures.

2.0 PURPOSE

The purpose of this experiment was to determine if aggregate degradation occurs in a bituminous mixture when heated inside the NCAT Asphalt Content Tester. In addition, if aggregate degradation does occur, to quantify the extent of the degradation.

3.0 APPARATUS

3.1 NCAT Asphalt Content Tester--The NCAT Asphalt Content Tester is a forced-air ignition furnace, with internal balance, capable of maintaining a temperature of 538° C (1000° F). The NCAT Asphalt Content Tester consists of an electronic housing unit, an oven chamber and an exhaust chamber. The electronic housing unit is located underneath the oven chamber and is separated by an air space. This area of the unit houses the electronic controls as well as the internal scale used to monitor weight loss. The oven chamber is located in the middle of the unit. The oven chamber is heated electrically using ceramic heating elements. A hearth tray located inside the oven chamber is supported by ceramic tubes which extend down to the internal scale. The accuracy of the internal scale balance is verified by placing calibrated weights on the hearth tray at room temperature. The exhaust chamber is located above the oven chamber. An exhaust fan and filters are used to control the smoke and fumes while testing.

3.2 Basket Assemblies--Two stainless steel 2.36mm (No. 8) mesh perforated basket assemblies were nested on top of each other with a drip pan located on the bottom of the assembly. This configuration allowed the bituminous mixture increased surface area exposure and facilitated more complete burning of the AC.

3.3 Asphalt Mixer and Mixer Bowl--A HOBART mechanical mixer (Model N50) with an approximate capacity of 5 liters and capable of mixing approximately 1250 grams of aggregate.

3.4 External Scale--An AND 20 kg capacity scale accurate to 0.1 gram was used in this experiment.

3.5 No. - 200 Wash Sieve Screen--A 304.8 mm (12 inch) diameter 0.075 mm (No. 200) sieve was used to wash the minus 0.075mm (No. 200) material from the Experimental and Control specimens before performing the subsequent gradation analysis on the remaining aggregate.

3.6 Set of Nine 203.2 mm (8 inch) Diameter Sieves--A set of sieves having a 203.2 mm (8 inch) diameter, with sieve openings conforming to ASTM E-11. The sieve sizes used were: 12.5 mm, (1/2 inch); 9.5 mm, (3/8 inch); 4.75 mm, (No.4); 2.3 mm, (No.8); 1.18 mm, (No.16); 0.625 mm, (No.30); 0.3 mm, (No.50); 0.15 mm, (No.100): and 0.075 mm, (No.200). A ROTAP mechanical sieve shaker (Model RX-29) was used to separate the aggregate into different particle sizes.

3.7 Set of Three 304.8mm (12 inch) Diameter Sieves--A set of three 304.8 mm (12 inch) diameter sieves with screen sizes of + 9.5 mm (+ 3/8 inch), + 4.75 mm

(+ No. 4) and - 4.75 mm (- No. 4) were used to separate the aggregate into three different particle sizes prior to using the riffle sample splitter.

3.8 Riffle Sample Splitter--A sample splitter with 12, 37.5 mm (1 1/2 inch) equal width chutes was used to split the aggregate. Four chute catch pans were used.

3.9 Miscellaneous Equipment--A pan having dimensions of approximately (L x W x H) 38 x 38 x 5 cm was used for containing the residual aggregate after ignition. A steel wire brush was used to remove residual aggregate from the steel basket assembly after AC burn off.

4.0 PROCEDURE

4.1 Sources of Aggregate

Six aggregate sources were selected from various geographical areas which represented some of the varying aggregate types found within Colorado.

Table 1. Aggregate Source, Absorption, Mineralogy, Specific Gravity and Location

AGGREGATE SOURCE	CRSE/FINE AGGR. WATER % ABSORB (AASHTO)	MINERALOGY	CRSE/FINE AGGR. SPG (AASHTO)	LOCATION
Franciscotti	0.9, N/A	Sandstone Shale	2.66, 2.59	Walsen-burg
Ralston	0.72, 1.03	Quartz Diorite	2.77, 2.75	Denver
Valco/Rocky Mtn./Cas	0.9, 0.8	Decomposed Granite	2.62, 2.61	Colo. Springs
Irwin Windsor-Stute	0.8, 0.4	Feldspar	2.61, 2.66	Fort Collins
Monk	0.8, N/A	Granite	2.64, N/A	Limon
Pagosa Trout Lakes	2.1, 1.7	N/A	2.54, 2.51	Pagosa Springs

4.2 Aggregate Set Up

Six different (10000 gram) aggregate sources of grading CX, 12.5 mm (1/2 inch) nominal maximum, were set up together using six different aggregate blend formulas.

4.3 Separating and Splitting Aggregate

In a attempt to reduce segregation, the 10K gram samples were separated into three different sieve sizes, + 9.5 mm (+ 3\8), + 4.75 mm (+ No.4) and - 2.36 mm (- No.4) using three 304.8 mm (12 inch) diameter sieves. The three different sizes of aggregate were split individually three times using a riffle sample splitter. The aggregate from each of the three sieve sizes were combined which resulted in eight specimens of approximately 1250 grams each. This method was used to increase the probability for an even split when the larger aggregate sizes were dropped through the riffle sample splitter. To further reduce the margin of error between specimens, the four Control and four Experimental specimens were collected from alternate sides of the sample splitter.

4.4 Combining with Hydrated Lime and Water

All eight (approximately 1250 gram) aggregate specimens from each of the six aggregate sources were mixed with one percent hydrated lime and approximately four percent water, oven dried inside a 121°± 5 C (250° F) oven for 6 ± 1 hours and then cooled to room temperature. Removing the moisture was important since aggregates that have high absorption values may retain moisture which may cause the aggregate to "pop" (break apart changing the gradation) inside the NCAT Asphalt Content Tester.

4.5 Treatment of Control Specimens

The Control specimens were stored on a shelf at room ambient temperature and humidity until gradations could be performed as described in Section 4.7

4.6 Rational for Mixing the Experimental Specimens with AC

Mixing the aggregate specimens with asphalt cement was thought to be an important factor since these specimens would be exposed to higher temperatures (greater than 538° C (1000° F)) inside the ignition oven (compared to aggregate only specimens) as the asphalt cement burns. Aggregate mixed with asphalt typically burns in the oven at 600° C (1112° F) to 700° C (1292° F). These higher temperatures may increase the probability that the aggregate degrades. In addition, the aggregate which will be evaluated for gradation during the life of construction projects will also be mixed with asphalt cement when determining asphalt cement content.

4.6.1 Treatment of Experimental Specimens

The four Experimental specimens were re-heated again inside a 148 +/- 5° C (300° F) oven for 3 $\pm$ 1 hours and mixed with approximately five percent AC, (Conoco AC-10).

The bituminous mixture specimens were placed inside the NCAT Asphalt Content Tester (at a set point temperature of 538° C (1000° F)) immediately after the mixing process and tested per CPL-5120, see Appendix E. The AC in the bituminous mixture was ignited and burned away leaving the residual aggregate. The residual aggregate was cooled for approximately one-half hour inside the basket assembly and then collected in a steel pan. The Experimental specimens were stored on a shelf (less than 24 hours) until gradations could be performed per Section 4.7

4.7 Gradations

Gradations following AASHTO T 27 (Sieve Analysis of Fine and Coarse Aggregates) and T 11 (Amount of Material Finer Than 0.075 mm Sieve in Aggregate) were performed on each of the eight specimens from each of the six aggregate sources. A ROTAP mechanical sieve shaker was used as described in Section 3.1, to separate the aggregate into different size fractions.

Table 2. Number of Gradations Performed per Sieve Size

Sieve Size	No. of Control Specimens Per Aggregate Source	No. of Exp. Specimens Per Aggregate Source	No. of Aggregate Sources	Total No. of Grad. Per Sieve Size
Each of the nine sieve sizes	4	4	6	48

4.8 Methods of Analysis

There were two methods used to analyze the gradation results after using the ignition oven.

4.8.1 First Method of Analysis (Comparison of the Mean of the Experimental and Control Specimens)

The first method of analysis compared the mean of the gradations between the four Experimental and four Control specimens. The "mean difference" for the percent passing each sieve size for each aggregate source was calculated by subtracting the average (mean of the four Control specimens) of the original design gradation from the average (mean of the four Experimental specimens) of the residual aggregate specimens after using the NCAT Asphalt Content Tester.

In addition, Confidence Interval and Frequency graphs were generated. The Student's t-Test for a paired two sample comparison was also used to determine if the gradation results from the Control and Experimental specimens were statistically from the same population set. A 95 % confidence level was used. The t-test data was also used to generate the Confidence Interval figures *(1)*.

4.8.2 Second Method of Analysis (One-to-One Comparison between Experimental and Control Specimens)

The second method compared the gradation results between the Experimental and Control specimens on a one-to-one basis. All possible combinations of the Experimental and Control specimens were paired per sieve size and their percent differences were calculated. The sample standard deviations were

calculated for each of the nine sieve sizes. The standard deviations calculated from each of the sieve sizes were compared to the single standard deviations found in the precision statement of AASHTO T 27.

5.0 GRADATION RESULTS AND DISCUSSION

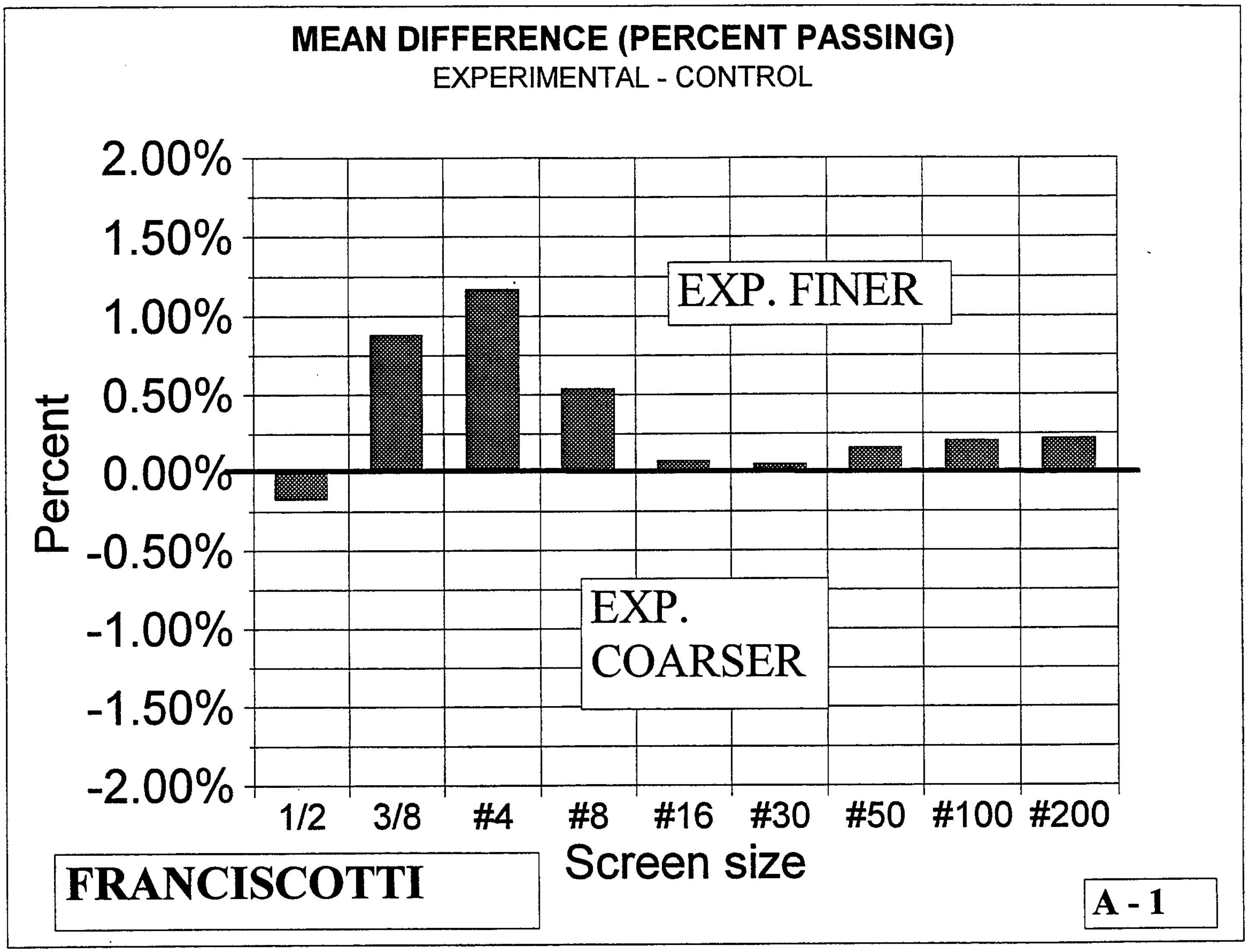
5.1 Analysis Method One (Aggregate Gradation Results)

In Sections 5.1.1 - 5.1.6 and 6.1.1 - 6.1.4 the "mean difference" refers to the average of the percent passing the four **Experimental** specimens minus the average of the percent passing the four **Control** specimens calculated for each of the sieve sizes.

5.1.1 Mean Differences Between the Control and Experimental Specimens Illustrated for the Franciscotti Aggregate Source

Figure 1. represents the mean differences calculated for each sieve size for the Franciscotti aggregate source. The analysis, data and figures for all of the aggregate sources can be found in Appendix A.

Figure 1. Mean Differences Illustrated For Each of the Nine Sieve Sizes Representing The Franciscotti Aggregate Source



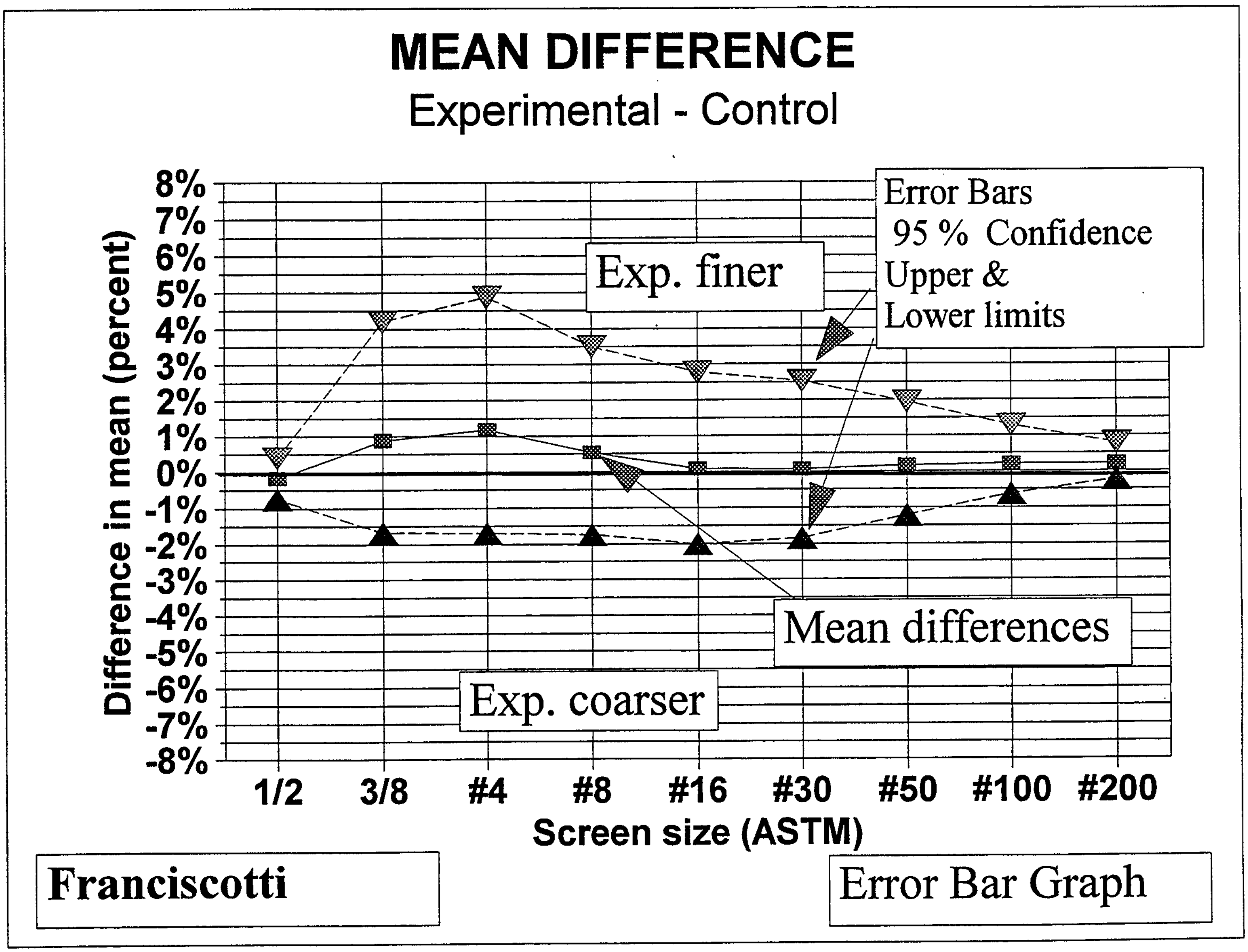
After the mean differences for the percent passing each sieve size were calculated for the six aggregate sources, 45 out of the 54 sieves had more material passing each sieve, (the Experimental specimens were finer than the Control specimens).

The mean differences for the percent passing each sieve size were greater than 1.0 percent, but less than 1.75 percent for only three out of the 54 sieves tests (nine sieve sizes times six aggregate sources). The 9.5 mm (3/8 inch) sieve sizes from the Monk and Ralston aggregate source, and the 4.5 mm (No.4) sieve size from the Franciscotti aggregate source were the only sieves in which there were mean differences that were greater than 1.0 percent. The remaining 51 sieve test mean differences were all less than 1.0 percent.

5.1.2 Confidence Interval Figure Displaying the Upper and Lower Limits for the Franciscotti Aggregate Source

Figure 2. is a graphical representation illustrating the upper and lower confidence intervals for the Franciscotti aggregate source. The remaining illustrations representing the other aggregate sources may be found in Appendix B. The data used to calculate the confidence interval limits were generated by applying the Student's t-test for paired samples. The data used to generate the figures may also be found in Appendix B.

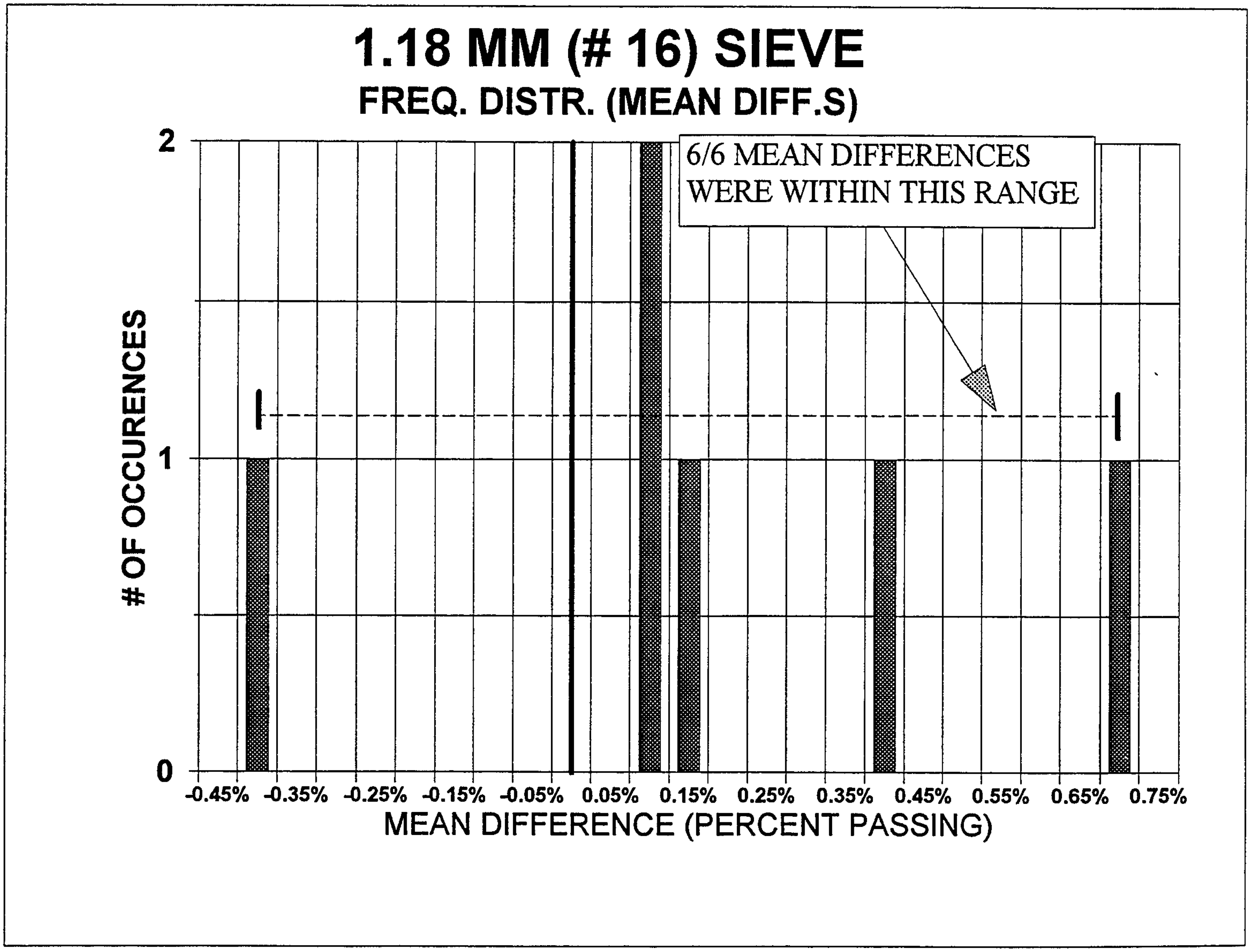
Figure 2. Confidence Intervals Representing the Upper and Lower Limits For The Franciscotti Aggregate Source



5.1.3 Frequency Distribution Illustrating the Mean Differences for the 9.5 mm (3/8) Sieve Size

Figure 3 represents the range between the mean differences for each of the six aggregate sources for the 9.5 mm (3/8) sieve size. The remainder of the figures representing the other sieve sizes used in this study may be found in Appendix C. The figures demonstrate that the range between the lowest and highest mean differences were normally less than 1.0 percent. Occurrences which deviated further away from the concentrated group of the mean differences may have been due to the splitting or mechanical mixing process, or the aggregate may have degraded during ignition process.

Figure 3. Frequency Distribution Displaying The Mean Differences Representing The 1.18 mm (# 16) Sieve



5.1.4 Frequency Distribution for the 54 Sieve Tests

Figure 4 represents the frequency distribution of the mean differences for the 54 sieve tests. The mean calculated for the "mean differences" as defined in Section 4.8 for all of the 54 sieve tests was 0.32 percent.

Figure 4. Frequency Distribution Of The Mean Differences For 54 Sieve Tests

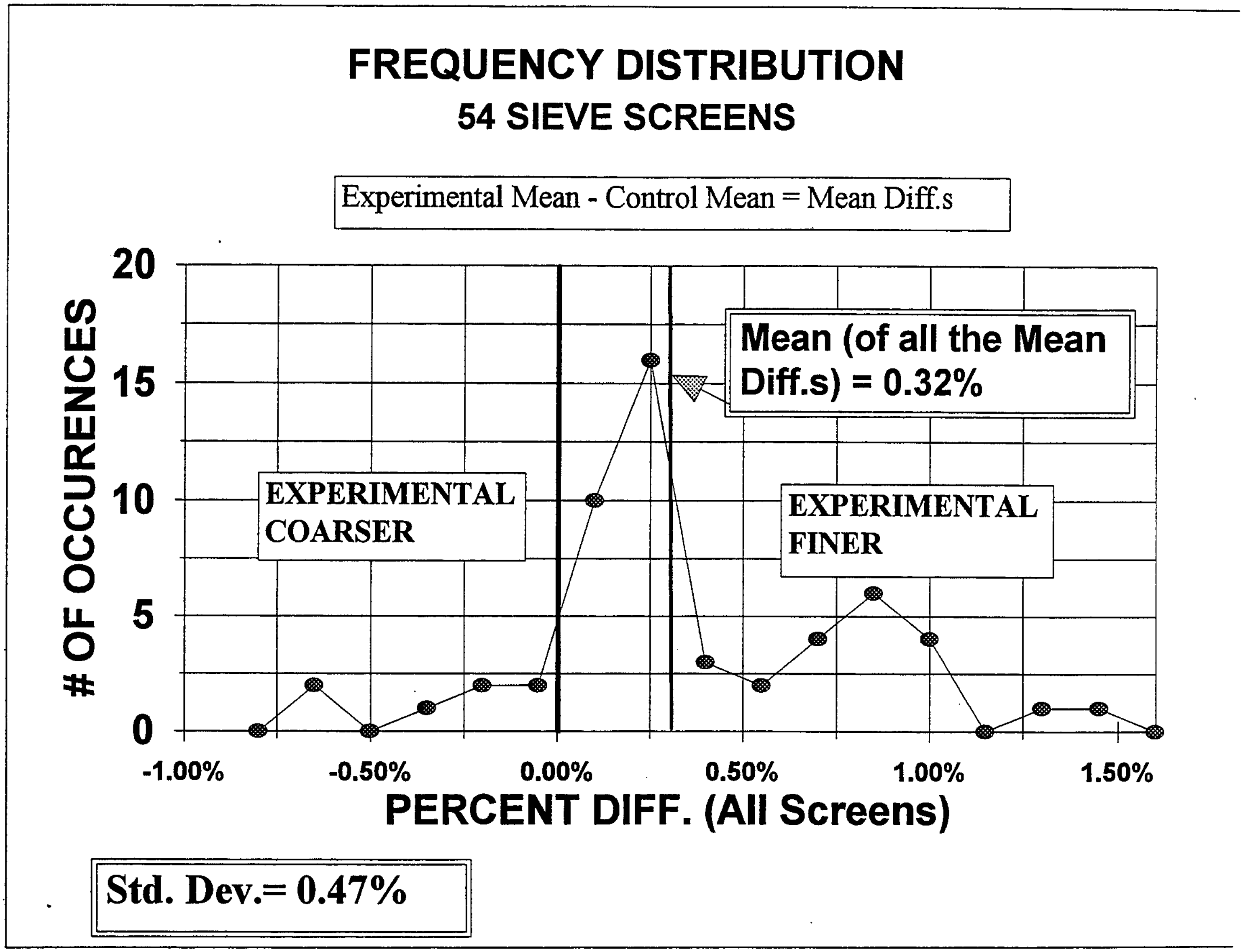


Table 3. Data used to generate Figure 4.

NCAT OVEN GRADATION STUDY

FREQUENCY GRAPH

12-19-95 SCREEN SIZE	DATA VALUES mean diff.	SCREEN metric	SCALE X-AXIS PERCENT, RANGE	TIMES OCCURED frequency
1/2	-0.17%	12.5	-0.80%	0
1/2	-0.78%	12.5	-0.65%	2
1/2	-0.03%	12.5	-0.50%	0
1/2	0.03%	12.5	-0.35%	1
1/2	0.08%	12.5	-0.20%	2
1/2	0.24%	12.5	-0.05%	2
3/8	0.88%	9.5	0.10%	10
3/8	1.44%	9.5	0.25%	16
3/8	-0.30%	9.5	0.40%	3
3/8	0.53%	9.5	0.55%	2
3/8	1.68%	9.5	0.70%	4
3/8	0.11%	9.5	0.85%	6
#4	1.17%	4.75	1.00%	4
#4	0.81%	4.75	1.15%	0
#4	0.80%	4.75	1.30%	1
#4	0.07%	4.75	1.45%	1
#4	0.10%	4.75	1.60%	0
#4	0.23%	4.75		
#8	0.54%	2.3		
#8	0.19%	2.3		
#8	0.80%	2.3		
#8	0.38%	2.3		
#8	-0.77%	2.3		
#8	0.86%	2.3		
#16	0.07%	1.18		
#16	0.15%	1.18		
#16	0.05%	1.18		
#16	0.36%	1.18		
#16	-0.41%	1.18		
#16	0.67%	1.18		
#30	0.05%	0.625		
#30	0.18%	0.625		
#30	-0.21%	0.625		
#30	0.71%	0.625		
#30	-0.10%	0.625		
#30	0.64%	0.625		
#50	0.16%	0.3		
#50	0.22%	0.3		
#50	0.13%	0.3		
#50	0.92%	0.3		
#50	-0.00%	0.3		
#50	0.65%	0.3		
#100	0.20%	0.15		
#100	0.16%	0.15		
#100	0.16%	0.15		
#100	0.87%	0.15		
#100	0.13%	0.15		
#100	0.58%	0.15		
#200	0.22%	0.075		
#200	0.12%	0.075		
#200	0.04%	0.075		
#200	0.76%	0.075		
#200	0.81%	0.075		
#200	0.39%	0.075		
STDS	0.47%			
MEAN	0.32%			

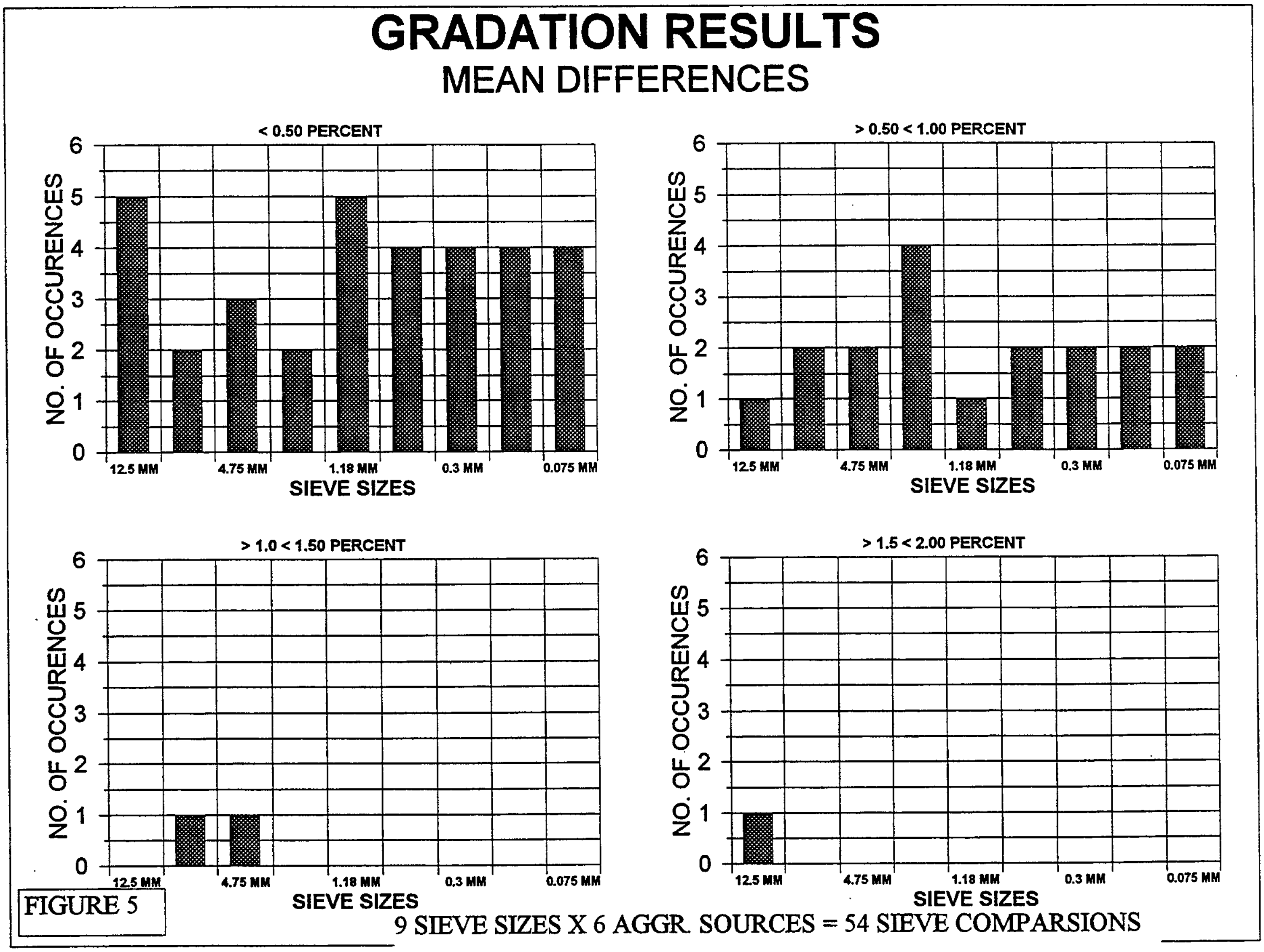
5.1.5 Experimental Specimens that Appeared Coarser after Using the NCAT Asphalt Content Tester

In some cases, when the mean differences were calculated for each sieve size after using the NCAT Asphalt Content Tester, the Experimental specimens appeared to be coarser. The 12.5 mm (1/2 inch) sieve from the Ralston aggregate source and the 12.5 mm (1/2 inch) and the 9.5 mm (3/8) sieve size from the Valco/Rocky Mountain aggregate source are examples of this. See Section 6.1.2 for an explanation of cases like these.

5.1.6 Summary of Results Using Analysis Method One

The results showing the ranges of the mean differences for the six different aggregate sources are shown in Figure 5.

Figure 5. Summary of the Gradation Results (Mean Differences, Analysis Method One)



Reviewing Figure 5 reveals that the ranges of the mean differences for the 54 sieve tests were generally less than 1.0 percent. Thirty three were less than 0.5 percent, eighteen were less than 1.0 percent, two were less than 1.5 percent and one was less than 2.0 percent.

Ninety four percent of the calculated mean differences for the percent passing each sieve screen were less than 1.0 percent. Only six percent of the mean differences were greater than 1.0 percent.

5.2 Analysis Method Two- Aggregate Gradation Results

The standard deviations were calculated using the percent differences from each of the 16 possible paired combinations between the four Experimental and four Control specimens for each individual sieve size. The single standard deviations from the precision statement in AASHTO T 27 were then subtracted from their respective sieve size standard deviations calculated from the 16 possible paired combinations.

5.2.1 AASHTO T 27 Precision (Single Operator)

The precision statement for an aggregate sample which was split one time is given in AASHTO procedure T 27. The precision (for a single operator) in determining the gradation per aggregate size is given in Table 4.

The estimates of precision for the method listed in AASHTO T 27 are based on results from the AASHTO Materials Reference Laboratory Reference Sample Program, with testing conducted by this method and ASTM C 136. The data is based on the analyses of more than 100 paired test results from 40 to 100 laboratories. The values in the table are given for different ranges of percentage of aggregate passing one sieve and retained on the next finer sieve. The Table uses ASTM C 670 Practice for Preparing Precision Statements for Test Methods For Construction Materials *(3)*. The data for the aggregate gradations tested in this study for the percent of aggregate passing one sieve and retained on the next finer sieve is shown on Table 5.

Table 4. Precision Statement from AASHTO T 27

TABLE 1 Precision

	Percent of Size Fraction Between Consecutive Sieves	Coefficient of Variation (1S percent), Percent[B]	Standard Deviation (1S), Percent[A]	Acceptable Range of Test Results	
				(D2S percent)[B] Percent of Average	(D2S),[A] Percent
Coarse Aggregates: [C]					
Single-Operator Precision	0 to 3	30[D]	—	85[D]	—
	3 to 10		1.4[D]		4.0[D]
	10 to 20		0.95		2.7
	20 to 50		1.38		3.9
Multilaboratory Precision	0 to 3	35[D]	—	99[D]	—
	3 to 10		1.06		3.0
	10 to 20		1.66		4.7
	20 to 30		2.01		5.7
	30 to 40		2.44		6.9
	40 to 50		3.18		9.0
Fine Aggregates:					
Single-Operator Precision	0 to 3		0.14		0.4
	3 to 10		0.43		1.2
	10 to 20		0.60		1.7
	20 to 30		0.64		1.8
	30 to 40		0.71		2.0
	40 to 50		—		—
Multilaboratory Precision	0 to 3		0.21		0.6
	3 to 10		0.57		1.6
	10 to 20		0.95		2.7
	20 to 30		1.24		3.5
	30 to 40		1.41		4.0
	40 to 50		—		—

[A] These numbers represent, respectively, the (1S) and (D2S) as described in ASTM C 670.
[B] These numbers represent, respectively, the (1S percent) and (D2S percent) limits as described in ASTM C 670.
[C] The precision estimates are based on coarse aggregates with nominal maximum size of 19.0 mm (3/4 in.).
[D] These values are from precision indices first included in T 27. Other indices were developed in 1982 from more recent AASHTO Materials Reference Laboratory sample data, which did not provide sufficient information to revise the values as noted.

Table 4 from the AASHTO T 27 procedure, allows a single standard deviation for the gradation blends used in this experiment with a range between 0.95 and 1.4 percent for coarse material and a range between 0.14 and 0.64 percent for fine material using a single operator. The values depend on the percentage passing one sieve and retained on the next finer sieve.

Table 5. Percent of Aggregate Passing One Sieve and Retained on the Next Finer Sieve for Each Aggregate Source

FRANCISCOTTI

EXPERIMENTAL SIEVE SIZE	AGGREGATE DESCRIPTION	PERCENT PASSING EACH SIEVE SIZE	PERCENT PASSING ONE SIEVE AND RETAINED ON THE NEXT FINER SIEVE	B AASHTO T 27 AFTER 1 SPLIT AGGREGATE ONLY 100 PAIRED TEST RESULTS PRECISION (1S),%
1/2	COARSE	99.66%		
3/8	COARSE	70.52%	29.14%	1.38
#4	FINE	45.84%	24.69%	0.64
#8	FINE	33.61%	12.23%	0.60
#16	FINE	24.79%	8.82%	0.43
#30	FINE	17.36%	7.43%	0.43
#50	FINE	11.32%	6.04%	0.43
#100	FINE	7.30%	4.02%	0.43
#200	FINE	4.60%	2.69%	0.14

WINDSOR/IRWIN

EXPERIMENTAL SIEVE SIZE	AGGREGATE DESCRIPTION	PERCENT PASSING EACH SIEVE SIZE	PERCENT PASSING ONE SIEVE AND RETAINED ON THE NEXT FINER SIEVE	B AASHTO T 27 AFTER 1 SPLIT AGGREGATE ONLY 100 PAIRED TEST RESULTS PRECISION (1S),%
SIEVE SIZE				
1/2	COARSE	99.81%		
3/8	COARSE	80.17%	19.64%	0.95
#4	FINE	59.51%	20.66%	0.64
#8	FINE	43.91%	15.60%	0.60
#16	FINE	32.09%	11.82%	0.60
#30	FINE	22.67%	9.42%	0.43
#50	FINE	14.63%	8.05%	0.43
#100	FINE	9.16%	5.47%	0.43
#200	FINE	5.88%	3.28%	0.43

RALSTON

EXPERIMENTAL

SIEVE SIZE	AGGREGATE DESCRIPTION	PERCENT PASSING EACH SIEVE SIZE	PERCENT PASSING ONE SIEVE AND RETAINED ON THE NEXT FINER SIEVE	B AASHTO T 27 AFTER 1 SPLIT AGGREGATE ONLY 100 PAIRED TEST RESULTS PRECISION (1S),% COMBINATIONS PRECISION (D2S),%
1/2	COARSE	98.17%		
3/8	COARSE	81.19%	16.99%	0.95
#4	FINE	66.56%	14.63%	0.6
#8	FINE	41.61%	24.95%	0.64
#16	FINE	26.68%	14.93%	0.6
#30	FINE	16.92%	9.77%	0.43
#50	FINE	8.99%	7.93%	0.43
#100	FINE	5.01%	3.97%	0.43
#200	FINE	2.74%	2.28%	0.14

MONK

EXPERIMENTAL

SIEVE SIZE	AGGREGATE DESCRIPTION	PERCENT PASSING EACH SIEVE SIZE	PERCENT PASSING ONE SIEVE AND RETAINED ON THE NEXT FINER SIEVE	B AASHTO T 27 AFTER 1 SPLIT AGGREGATE ONLY 100 PAIRED TEST RESULTS PRECISION (1S),%
1/2	COARSE	99.29%		
3/8	COARSE	81.99%	17.30%	0.95
#4	FINE	64.10%	17.89%	0.60
#8	FINE	41.67%	22.43%	0.64
#16	FINE	29.43%	12.24%	0.60
#30	FINE	21.19%	8.24%	0.43
#50	FINE	13.53%	7.65%	0.43
#100	FINE	7.85%	5.69%	0.43
#200	FINE	4.34%	3.50%	0.43

VALCO

EXPERIMENTAL

SIEVE SIZE	AGGREGATE DESCRIPTION	PERCENT PASSING EACH SIEVE SIZE	PERCENT PASSING ONE SIEVE AND RETAINED ON THE NEXT FINER SIEVE	B AASHTO T 27 AFTER 1 SPLIT AGGREGATE ONLY 100 PAIRED TEST RESULTS PRECISION (1S),%
1/2	COARSE	99.79%		
3/8	COARSE	74.15%	25.64%	1.38
#4	FINE	61.42%	12.73%	0.60
#8	FINE	45.51%	15.91%	0.60
#16	FINE	35.18%	10.33%	0.60
#30	FINE	25.81%	9.37%	0.43
#50	FINE	11.86%	13.95%	0.60
#100	FINE	5.01%	6.85%	0.43
#200	FINE	2.77%	2.24%	0.14

PAGOSA

EXPERIMENTAL

SIEVE SIZE	AGGREGATE DESCRIPTION	PERCENT PASSING EACH SIEVE SIZE	PERCENT PASSING ONE SIEVE AND RETAINED ON THE NEXT FINER SIEVE	B AASHTO T 27 AFTER 1 SPLIT AGGREGATE ONLY 100 PAIRED TEST RESULTS PRECISION (1S),%
1/2	COARSE	100.00%		
3/8	COARSE	75.54%	24.46%	1.38
#4	FINE	51.29%	24.25%	0.64
#8	FINE	36.74%	14.55%	0.60
#16	FINE	26.02%	10.72%	0.60
#30	FINE	18.76%	7.26%	0.43
#50	FINE	13.00%	5.76%	0.43
#100	FINE	8.80%	4.20%	0.46
#200	FINE	6.13%	2.67%	0.14

5.2.2 (Experimental - Control) Data Minus AASHTO T 27 (Single Standard Deviation Data)

Figure 6 represents the differences between the standard deviations for the aggregate specimens that were split three times, mixed with asphalt cement, and then heated inside the NCAT Asphalt Content Tester minus the single split precision of a paired aggregate sample. The differences in the standard deviations are due to the splitting, mechanical mixing, and heating of the aggregate inside the NCAT Asphalt Content Tester. There appears to be between 0.9 percent to 1.75 percent difference for the 9.5 mm (3/8), 4.75 mm (#4), 2.36 mm (#8), 1.18 mm (#16), and 0.60 mm (#30) sieves. There is less of a difference for the smaller sieve sizes of between 0.0 and 0.75 percent difference for the 0.30 mm (#50), 0.15 mm (#100) and the 0.075 mm (#200) sieve sizes.

Figure 6. (Experimental - Control Data) Minus AASHTO T 27 (Single Standard Deviation Data)

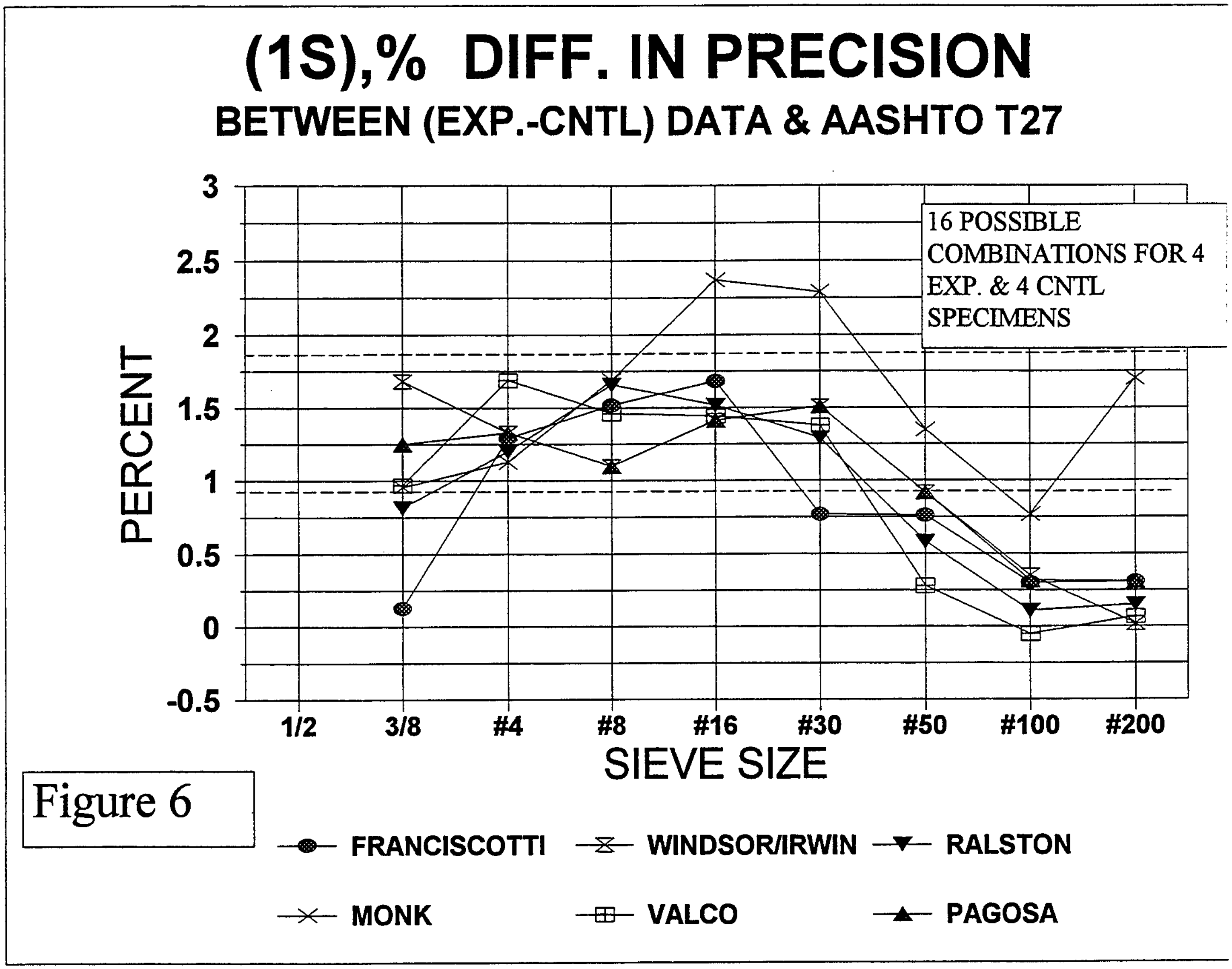


Figure 6

5.2.3 Control Data Minus AASHTO T 27 (Single Standard Deviation Data)

In a attempt to measure the error induced when the aggregate was split three times the standard deviations of the percent differences were also calculated from the six possible paired combinations using the four Control specimens only.

The single standard deviations from the precision statement in AASHTO T 27 were also subtracted from the standard deviations of each respective sieve size from the six possible paired combinations. The results are illustrated in Figure 7. Figure 7 represents the (Control specimens) aggregate that were split three times but not mixed with asphalt cement or heated inside the NCAT Asphalt Content Tester.

Figure 7. Control Data Minus AASHTO T 27 (Single Standard Deviation Data)

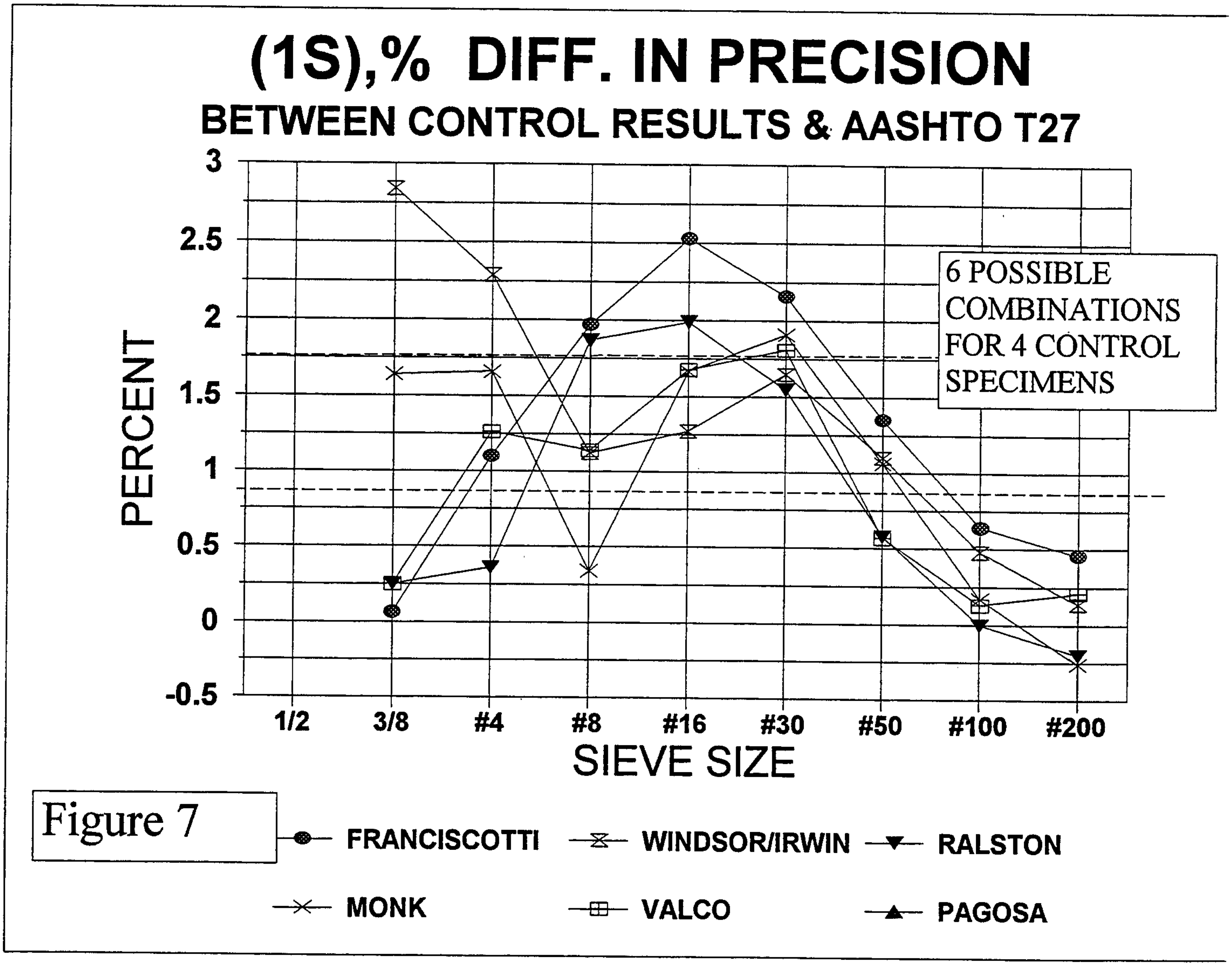


Figure 7

5.2.4 (Single Standard Deviation Data, Figure 8)

In an attempt to reveal the effects that the ignition oven may have had on the aggregate, the differences between the standard deviations for Figure 6 and Figure 7 were determined.

The differences between the single standard deviations for Figure 6 and Figure 7 are illustrated in Figure 8.

Figure 8. Difference Between Figure 6 and Figure 7 (Single Standard Deviation)

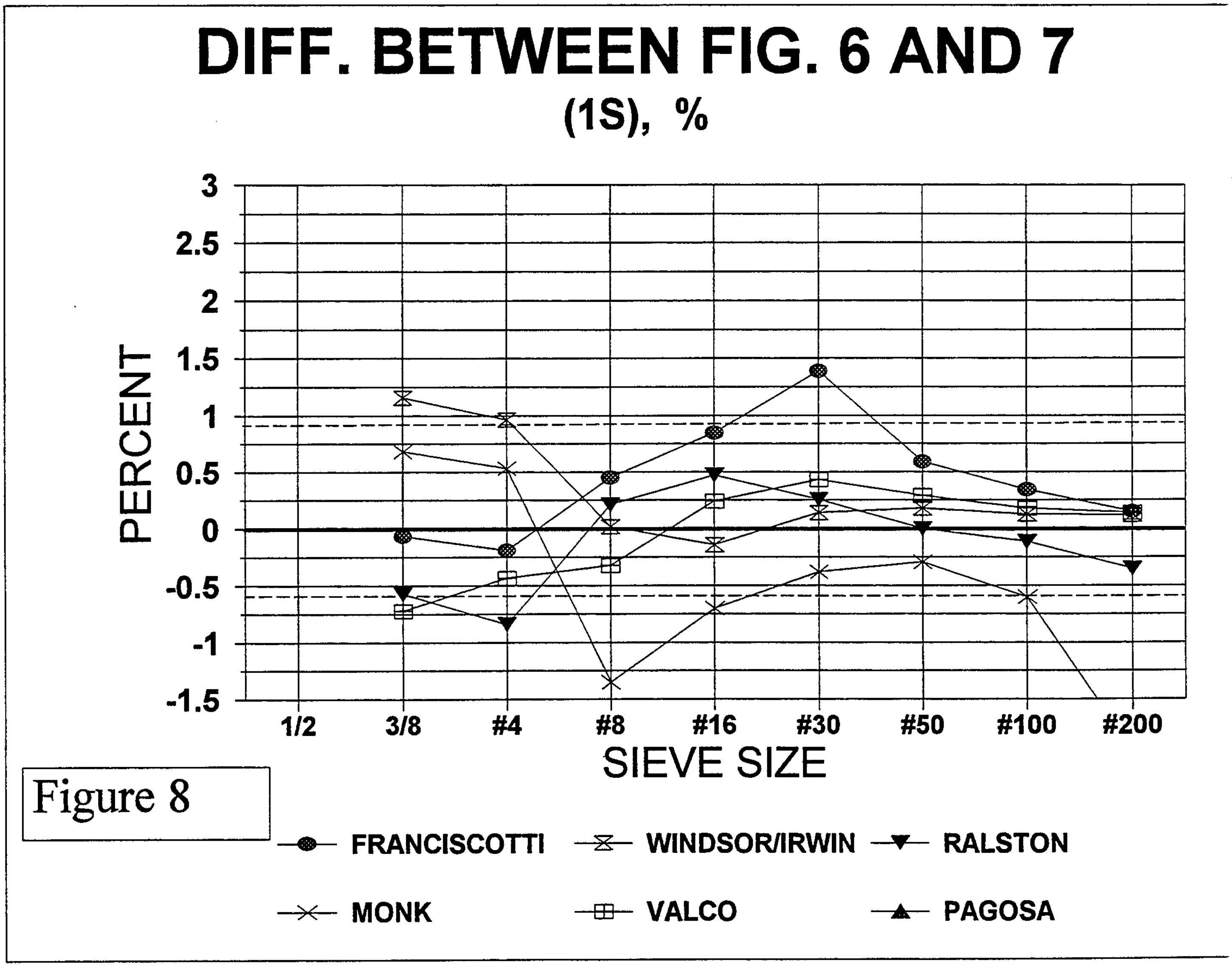


Figure 8

5.2.5 Summary of Results Using Analysis Method Two

The area which contains the majority of the points plotted for the percent difference in precision were reduced from a upper and lower range of +0.75 to +1.8 percent for Figure 6 to a upper and lower range of -0.6 to +0.6 percent for Figure 8. The percent differences in standard deviations were significantly reduced when the error due to splitting was alleviated.

5.3 Application of Correction Factors

Correction factors may be required to compensate for possible aggregate degradation inside the ignition oven.

Note: The data obtained from this experiment represents only the aggregate that was tested, individual aggregates should be tested separately for their susceptibility to degradation when placed inside the NCAT Asphalt Content Tester. Anyone using the ignition oven to determine aggregate gradation from a bituminous mixture should be aware of the possibility that aggregate sources other than the ones used in this study may degrade more under the high temperatures present inside the NCAT Asphalt Content Tester.

5.3.1 Testing for the Possibility of Aggregate Degradation

Aggregate degradation may be tested for by splitting a sample of a <u>known</u> gradation one time, producing paired specimens. The sample shall meet the minimum test weight requirements specified by AASHTO 27 (Section 6.4 - Sampling). One of the paired aggregate specimens shall be mixed with the appropriate amount of water and hydrated lime and dried in an exhaust oven at the proper mixing temperature along with the asphalt sample. The aggregate specimen and the asphalt sample shall be removed from the exhaust oven and mixed with the asphalt using a mechanical mixer. The bituminous mixture is than heated inside the ignition oven and tested. The other paired specimen shall be treated as the Control specimen as specified in Section 4.0 of this paper.

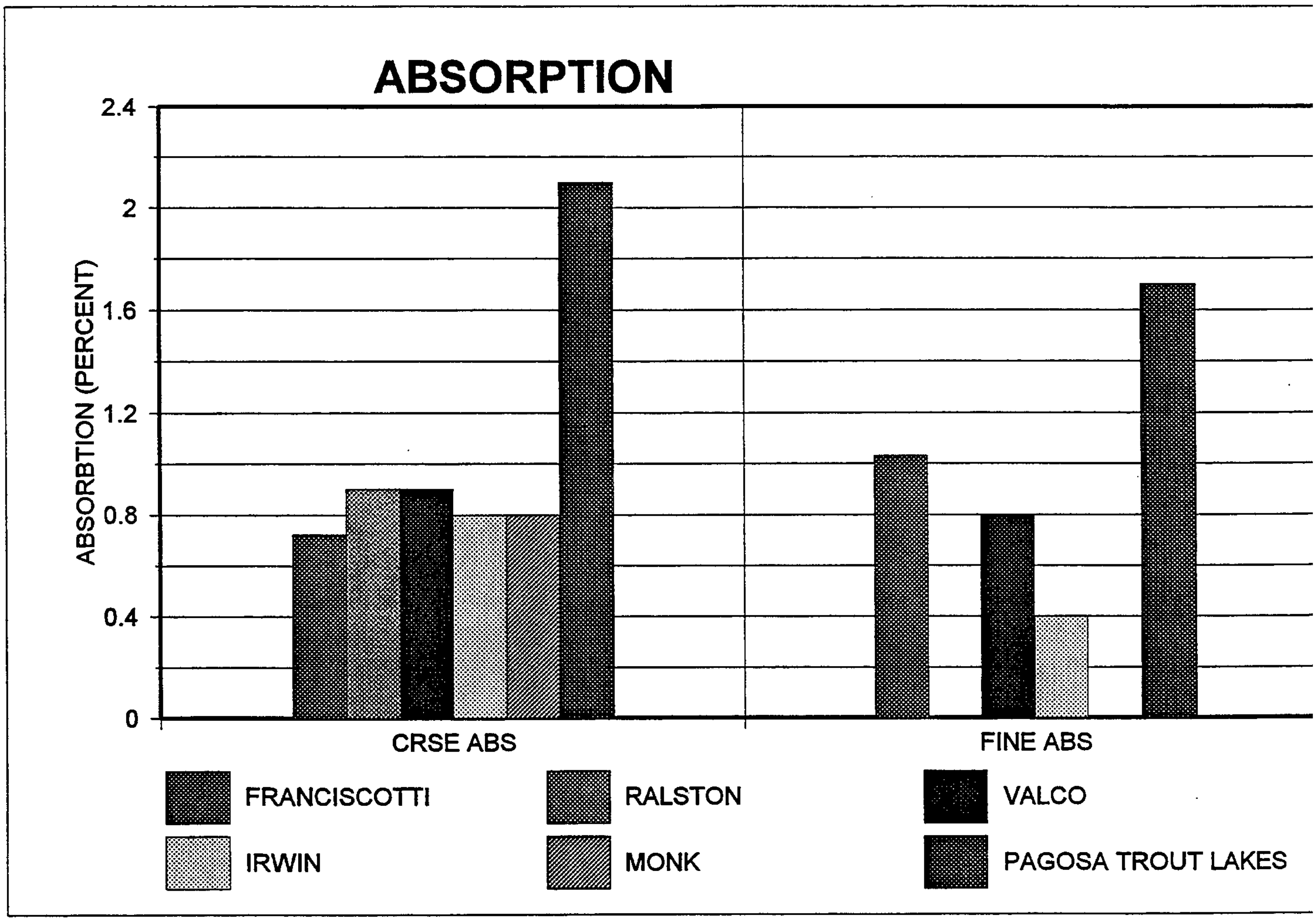
This procedure shall be repeated three times using three separate known aggregate gradation samples from the same source. The percent differences from each sieve size for the paired specimens shall be calculated for each of the three samples. The standard deviation shall be calculated using the results of the percent differences between the Control and Experimental specimens.

If the standard deviation calculated for the three samples exceeds the single standard deviation (1S),% limits as stated in AASHTO T 27, a correction factor will be required. The correction factor will be equal to the calculated standard deviation minus single standard deviation stated in AASHTO T 27. A correction factor will be required on any sieve size in which the calculated standard deviation for that sieve exceeds the (1S),% single standard deviation limits set fourth in the precision statement of AASHTO T 27. See Appendix D for the correction factors that were required using Analysis Method Two. See FUTURE RESEARCH Section 9.0 for additional information regarding this subject.

5.4 Aggregate Absorption Values

The porosity of an aggregate is generally indicated by the amount of water it absorbs when soaked in water. A porous aggregate will also absorb asphalt which will tend to make a bituminous mixture dry or less cohesive. The aggregate sources with higher absorption values did not demonstrate more degradation than aggregate sources with lower absorption values. Absorption values for the aggregate sources evaluated are shown in Table 1. The absorption values for each aggregate source are illustrated as follows on the following page.

Figure 9. Absorption Values for Each Aggregate Source



6.0 CONCLUSION

6.1 Analysis Method One

6.1.1 Mean Differences Between The Experimental and Control Specimen Gradations

The residual aggregate from the Experimental specimens were found to be finer than the Control specimens after performing a gradation analysis (45 out of the 54 sieve tests. This would indicate that there was some degradation caused by the NCAT Asphalt Content Tester or through the mechanical mixing process. However, the mean differences for the percent passing each sieve size between the Experimental and Control specimens were relatively low (less than 1.5 percent for nearly all the sieve sizes analyzed from each aggregate source).

6.1.2 Experimental Specimens that Appeared to be Coarser after Using the NCAT Asphalt Content Tester

In a few instances (see Section 5.1.5) the Experimental specimens appeared to be more coarse (less material passed through the sieves) after using the NCAT Asphalt Content Tester, this was a probably a result of the splitting or mechanical mixing process and <u>not</u> due to the ignition oven.

6.1.3 Possible Reasons for the Variation in Gradation Results

Possible reasons for the variances in gradation include several factors such as high temperature degradation, mechanical mixing and the splitting process.

6.1.4 Student's t-test

The data from each from the different sieve sizes for each of the aggregate sources clearly demonstrates the t-test statistic (t) is less than the t critical two tail . This means that one can be 95% confident that the two data sets came from the same population set. (See Appendix B).

6.1.5 Summary of Analysis Method One

Since the mean differences between the Experimental and the Control specimens for the percent passing each sieve size were less than 1.5 percent for nearly all the sieve sizes analyzed (coarse and fine aggregate) it may be deduced that heating the six bituminous mixture sources using the NCAT Asphalt Content Tester had only a small affect on the gradation. <u>The gradations between the Experimental and the Control specimens were not statistically different.</u>

6.2 Analysis Method Two (One to One Comparison)

6.2.1 (Experimental - Control) Data Minus AASHTO T 27 Gradation Data (Single Standard Deviation)

The differences in the single standard deviations for all of the sieve sizes ranged between 0.0 to 2.5 percent. The differences were due to either the splitting, mechanical mixing or aggregate breakdown inside the NCAT Asphalt Content Tester or a combination of all these effects.

6.2.2 Control Data Minus AASHTO T 27 Gradation Data (Single Standard Deviation)

The standard deviations for each sieve size were calculated after the percent differences were determined by combining different paired specimens using only the Control specimens. The standard deviations from each sieve size was subtracted from each of the AASHTO T 27 standard deviations respectively. The result of this subtraction represent the affect on the standard deviations for each sieve size after the aggregate was split three times. Nearly all of the significant differences between the standard deviations for the Control specimens and the AASHTO T 27 data were alleviated. (See Section 6.2.3) Therefore, it may be deduced that any difference between the single standard deviations given in AASHTO T 27 and the standard deviations calculated for the Control data was due to the error induced when the aggregate sample was split three consecutive times using a riffle splitter.

6.2.3 Figure 8 (Single Standard Deviation)

As shown in Figure 8, the percent differences between the standard deviations straddled the zero percent line. This would indicate that the percent differences measured were due largely to the differences caused when the aggregate sample was split three times, and not due to the mechanical mixing or heating of the aggregate inside the NCAT Asphalt Content Tester. <u>This would also indicate that the aggregate did not degrade excessively after using the ignition oven.</u> When the differences between the standard deviations for Figure 6 and 7 were compared to the standard deviations given in AASHTO T 27 only a small number of sieve sizes required a correction factor. Most of the correction factors were less than 1.0 percent. The correction factors that were required may be found in Appendix D.

6.3 Absorption Values

The absorption values of the aggregates that were tested did not appear to have affected the results of the gradations after using the NCAT Asphalt Content Tester after the moisture was removed per Section 4.4. The gradations of the aggregates with high absorption values were not noticeably different from the aggregate with low absorption values.

6.4 Summary of Analysis Methods One and Two

It may be deduced from analysis methods One and Two that the NCAT Asphalt Oven may have caused a slight amount of aggregate degradation. However, only a small number of the sieves required any correction factor, almost all correction factors were less than 1.0 percent. The test method listed in Section 5.3.1 may be used to determine the degree of aggregate degradation.

7.0 RECOMMENDATION

* The NCAT Asphalt Content Tester may be used for determining gradations of bituminous mixtures.

* Use of the NCAT Asphalt Content Tester can replace the use of chlorinated solvents for determination of AC content and aggregate gradation.

* Correction factors will be required for aggregate that is found to degrade inside the NCAT Asphalt Content Tester. See Section 5.3. Exceeding the precision limits set fourth in AASHTO T 27 shall be used as a reference in determining the requirement for gradation correction factors. Some types of aggregate (e.g. aggregate which contains oil shale on the Colorado West slope) may degrade excessively and unpredictably inside the ignition oven. For these types of aggregate the ignition oven may not be effective in determining gradation.

8.0 FUTURE RESEARCH

Aggregate degradation research may also be conducted by using only one aggregate specimen, without adding asphalt cement. This could be done by comparing the gradation of the specimen before using the ignition oven to the gradation after heating the same aggregate specimen inside the ignition oven for specified amount of time. This would provide a more instantaneous and time efficient method, if a technician in the field is questioned or suspects aggregate degradation (due to the particular mineralogy) is taking place when the specimen is heated inside the ignition oven.

Note: This method would not account for the elevated temperatures that would be present inside the oven chamber when asphalt cement is mixed with the aggregate. These temperatures would typically exceed the oven chamber set point of 538° C (1000° F).

9.0 REFERENCES

(1) Snedecor, W.G., and W.G. Cochran, Comparison of Two Samples, Chapter 6, *Statistical Methods* Eighth Edition. Iowa State Press, Ames Iowa 50010 1989, pp 84-86.

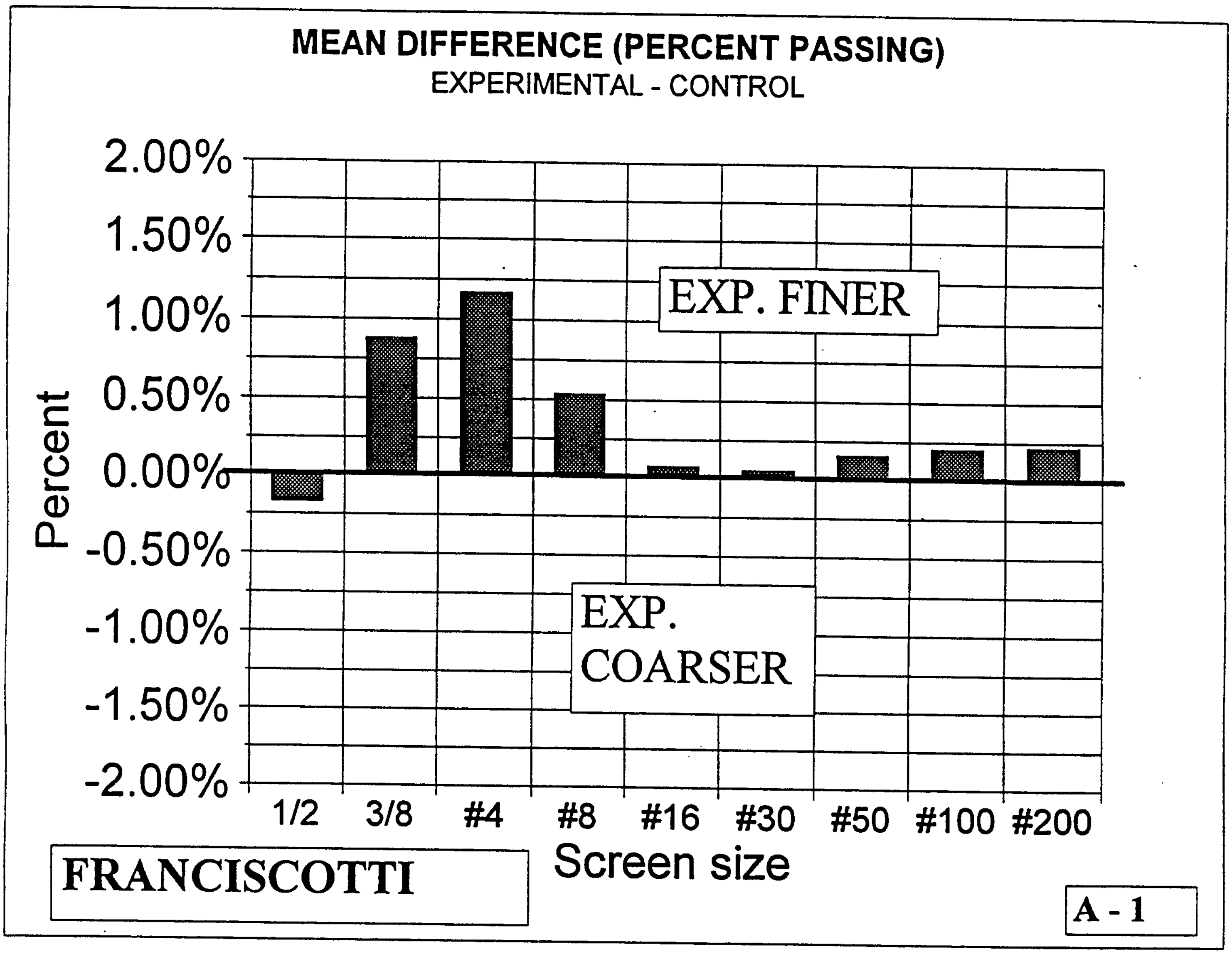
(2) 1995 *Standard Specifications for Transportation Materials and Methods of Sampling and Testing*, Seventeenth Edition, AASHTO T 27 Section 10.0 precision, pp 30-31.

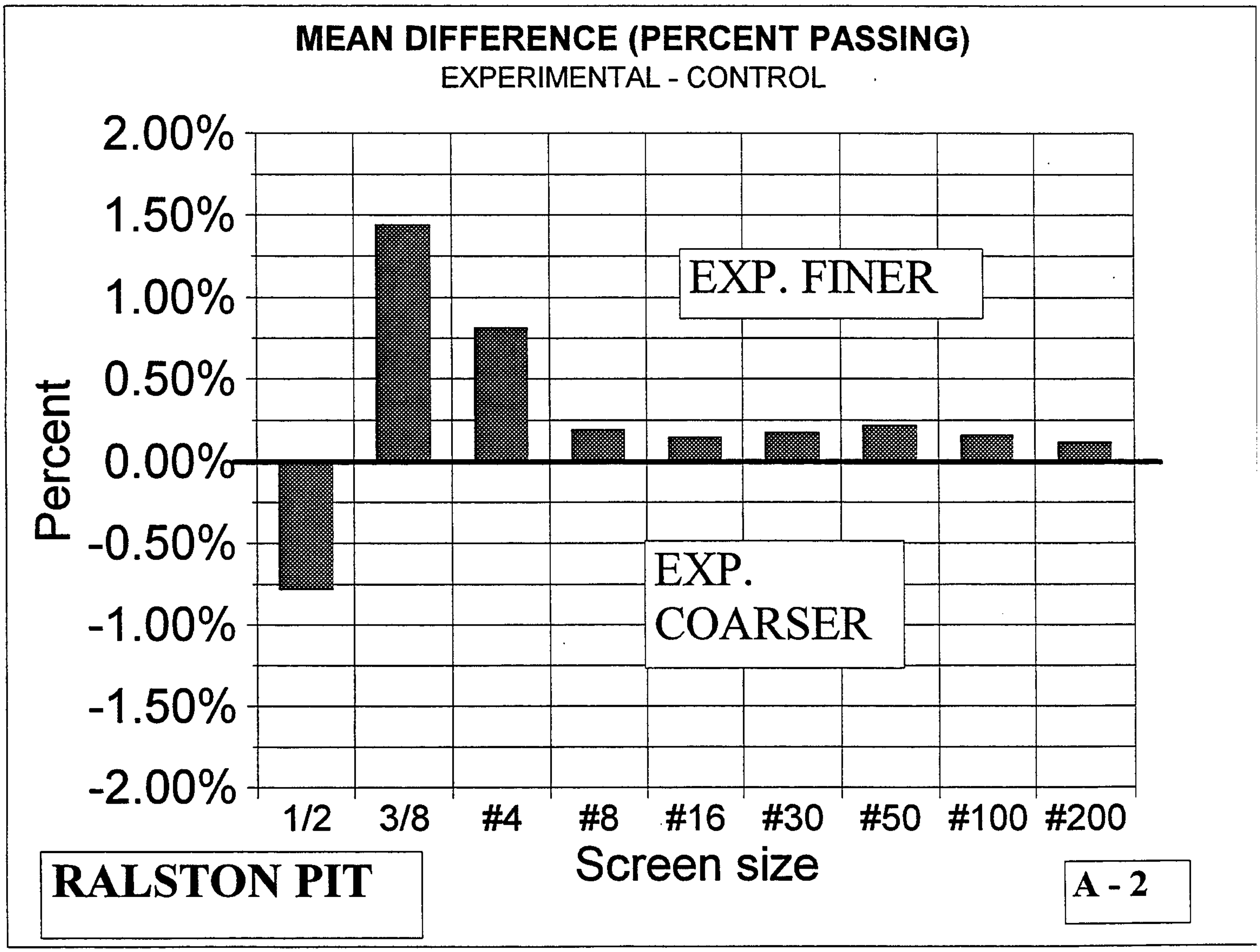
(3) 1996 *ANNUAL BOOK OF ASTM STANDARDS*, Concrete and Aggregates Volume 04.02, C 670 - 91a Standard Practice for Preparing Precision and Bias Statements for Test Methods for Construction Materials pp 48-49.

APPENDIX A

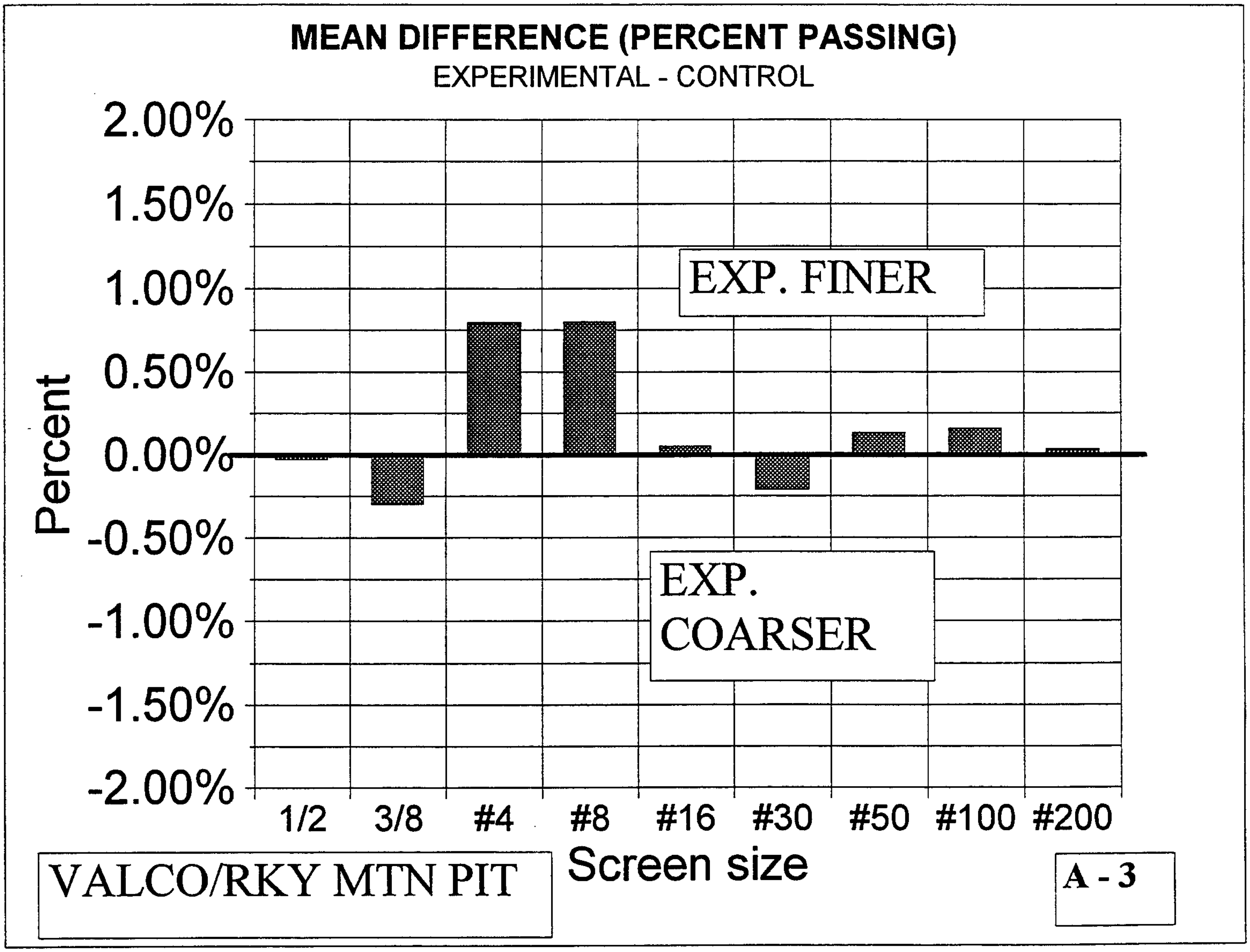
* Mean Difference Figures for Aggregate Sources

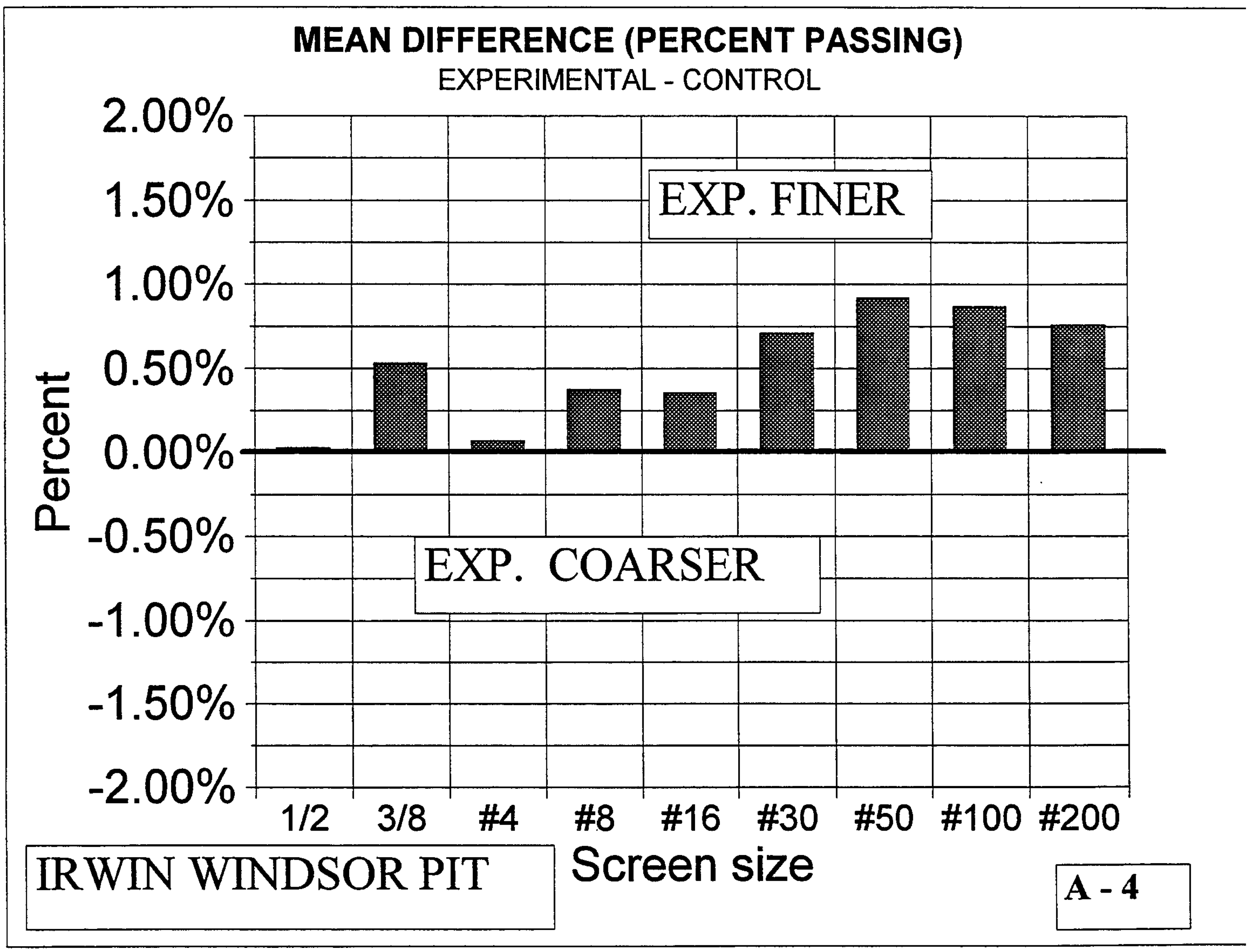
* Data Used to Calculate Mean Differences

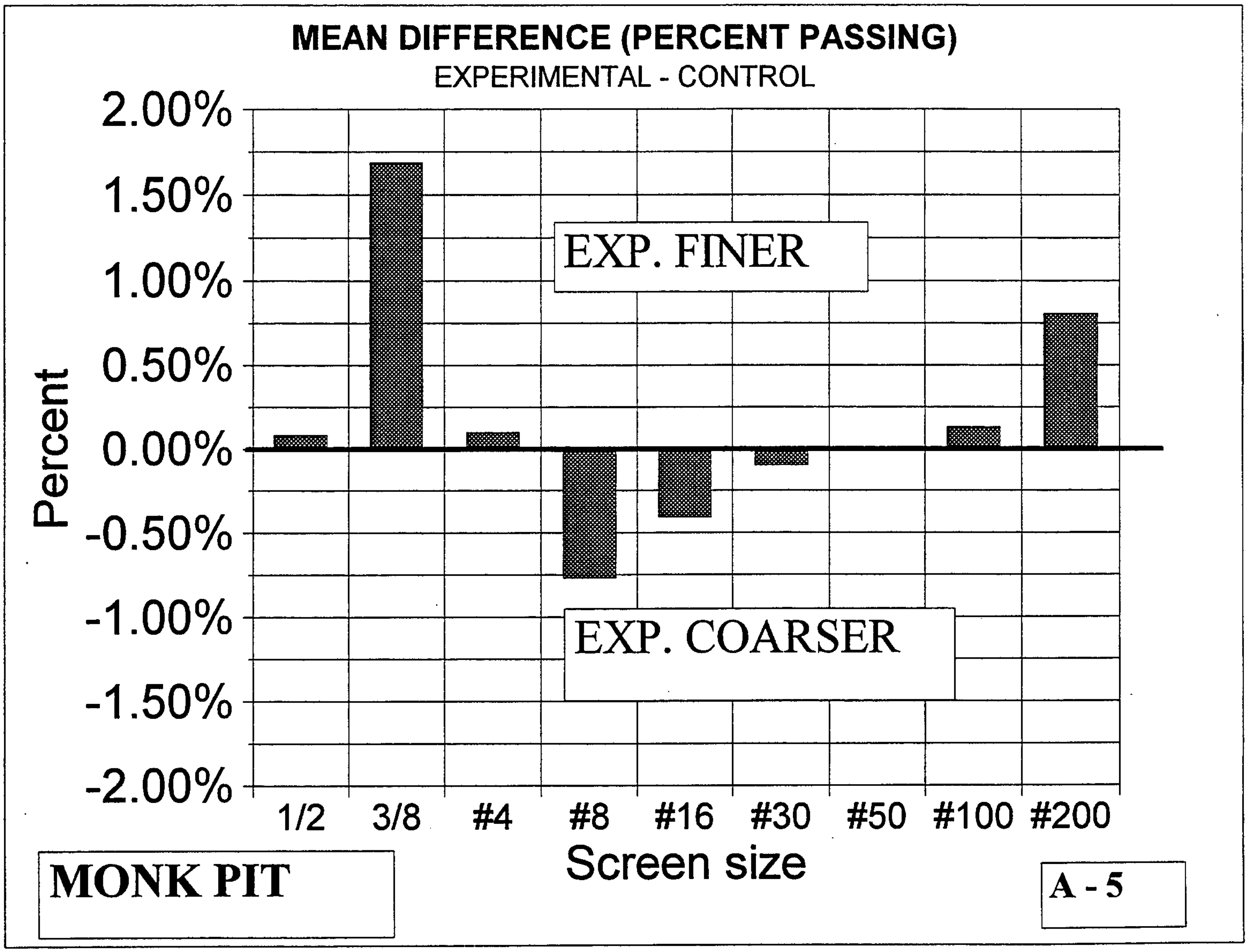

MEAN DIFFERENCE (PERCENT PASSING)
EXPERIMENTAL - CONTROL
2.00%
1.50%
1.00%
0.50%
0.00%
-0.50%
-1.00%
-1.50%
-2.00%
Percent
EXP. FINER
EXP. COARSER
1/2
3/8
#4
#8
#16
#30
#50
#100
#200
Screen size
FRANCISCOTTI
A - 1

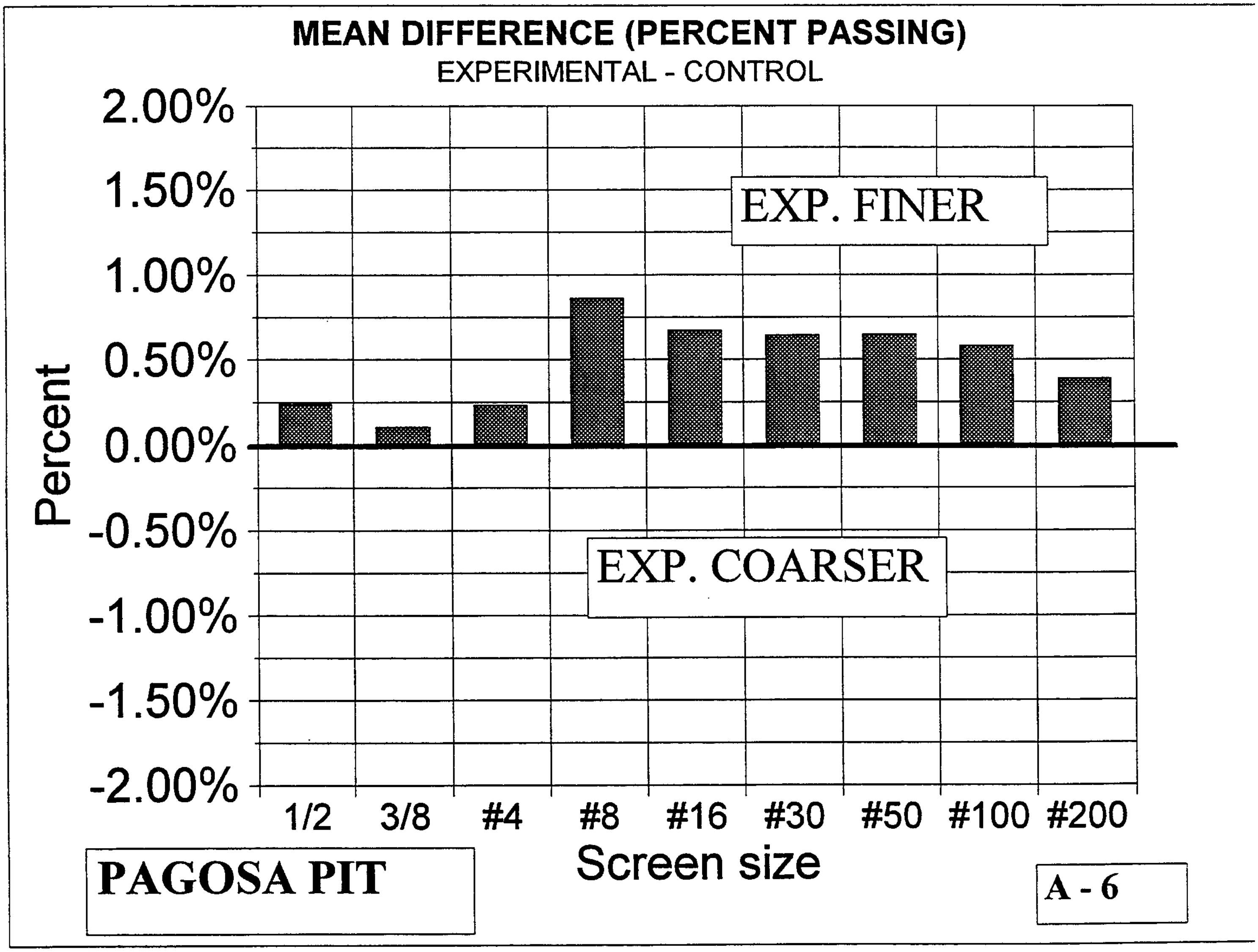


MEAN DIFFERENCE (PERCENT PASSING)
EXPERIMENTAL - CONTROL
2.00%
1.50%
1.00%
0.50%
0.00%
-0.50%
-1.00%
-1.50%
-2.00%
Percent
EXP. FINER
EXP.
COARSER
1/2
3/8
#4
#8
#16
#30
#50
#100
#200
Screen size
RALSTON PIT
A - 2


MEAN DIFFERENCE (PERCENT PASSING)
EXPERIMENTAL - CONTROL
2.00%
1.50%
1.00%
0.50%
0.00%
-0.50%
-1.00%
-1.50%
-2.00%
Percent
EXP. FINER
EXP.
COARSER
1/2
3/8
#4
#8
#16
#30
#50
#100
#200
Screen size
VALCO/RKY MTN PIT
A - 3


MEAN DIFFERENCE (PERCENT PASSING)
EXPERIMENTAL - CONTROL
2.00%
1.50%
1.00%
0.50%
0.00%
-0.50%
-1.00%
-1.50%
-2.00%
Percent
EXP. FINER
EXP. COARSER
1/2
3/8
#4
#8
#16
#30
#50
#100
#200
Screen size
IRWIN WINDSOR PIT
A - 4


MEAN DIFFERENCE (PERCENT PASSING)
EXPERIMENTAL - CONTROL
2.00%
1.50%
1.00%
0.50%
0.00%
-0.50%
-1.00%
-1.50%
-2.00%
Percent
EXP. FINER
EXP. COARSER
1/2
3/8
#4
#8
#16
#30
#50
#100
#200
Screen size
MONK PIT
A - 5


MEAN DIFFERENCE (PERCENT PASSING)
EXPERIMENTAL - CONTROL
2.00%
1.50%
1.00%
0.50%
0.00%
-0.50%
-1.00%
-1.50%
-2.00%
Percent
EXP. FINER
EXP. COARSER
1/2
3/8
#4
#8
#16
#30
#50
#100
#200
Screen size
PAGOSA PIT
A - 6

DATE: 8-13-96

SUMMARY OF t- TEST PAIRED TWO-SAMPLE FOR MEANS AND GRADATION RESULTS

GRADATION COMPARISON OF AGGREGATE MIXED WITH ASPHALT AND PLACED IN NCAT ASPHALT CONTENT OVEN (EXPERIMENTAL) VS. THE SAME AGGREGATE LEFT IN IT'S ORIGINAL STATE (CONTROL).

SIX AGGREGATE SOURCES ANALYZED

STUDENTS T - TEST EMPLOYED

PROBABILITY OF A LARGER VALUE
P(T<=t) two-tail: > .05

FRANCISSCOTTI PIT:

EXPERIMENTAL

SIEVE SIZE	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
596X-1	99.49%	71.45%	46.37%	32.88%	24.16%	17.23%	11.32%	7.27%	4.53%
596X-2	99.41%	69.52%	45.01%	33.65%	24.84%	17.34%	11.30%	7.35%	4.73%
596X-3	99.73%	70.47%	46.14%	33.72%	24.46%	16.77%	10.82%	6.98%	4.38%
596X-4	100.00%	70.66%	45.83%	34.17%	25.69%	18.11%	11.83%	7.59%	4.76%
MEAN	99.66%	70.52%	45.84%	33.61%	24.79%	17.36%	11.32%	7.30%	4.60%
STD DEV	0.26%	0.79%	0.59%	0.53%	0.66%	0.55%	0.41%	0.25%	0.18%

CONTROL

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
596X-5	99.59%	67.61%	42.44%	30.68%	22.43%	15.40%	9.78%	6.16%	3.78%
596X-6	100.00%	70.25%	44.52%	33.86%	26.36%	19.04%	12.45%	7.88%	4.80%
596X-7	100.00%	69.59%	44.26%	31.81%	23.13%	16.02%	10.40%	6.75%	4.25%
596X-8	99.72%	71.11%	47.45%	35.91%	26.94%	18.78%	12.00%	7.58%	4.69%
MEAN	99.8%	69.6%	44.7%	33.1%	24.7%	17.3%	11.2%	7.1%	4.4%
STD DEV	0.2%	1.5%	2.1%	2.3%	2.3%	1.9%	1.3%	0.8%	0.5%
MEAN DIFF	-0.2%	0.9%	1.2%	0.5%	0.1%	0.1%	0.2%	0.2%	0.2%
s sub D bar	0.18%	1.05%	1.17%	0.93%	0.85%	0.78%	0.56%	0.34%	0.18%
Mean DIFF + 3.18	0.40%	4.21%	4.88%	3.50%	2.77%	2.53%	1.94%	1.28%	0.79%
Mean DIFF - 3.18;	-0.75%	-1.7%	-1.7%	-1.7%	-2.0%	-1.9%	-1.2%	-0.6%	-0.2%
t	-0.9457	0.8431	1.0010	0.5779	0.0881	0.0675	0.2831	0.6005	1.2101
t critical two- tail	3.1824	3.1824	3.1824	3.1824	3.1824	3.1824	3.1824	3.1824	3.1824

RALSTON PIT:

EXPERIMENTAL

SIEVE SIZE	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
NCAT-1	97.60%	79.72%	65.03%	41.77%	27.93%	18.37%	10.02%	5.62%	3.01%

NCAT-2	98.76%	81.80%	66.62%	41.02%	26.01%	16.29%	8.48%	4.65%	2.44%
NCAT-3	98.11%	80.78%	65.69%	40.10%	24.91%	15.42%	8.09%	4.55%	2.56%
NCAT-4	98.23%	82.45%	68.90%	43.55%	27.88%	17.59%	9.35%	5.24%	2.93%
MEAN	98.17%	81.19%	66.56%	41.61%	26.68%	16.92%	8.99%	5.01%	2.74%
STD DEV	0.5%	1.2%	1.7%	1.5%	1.5%	1.3%	0.9%	0.5%	0.3%

CONTROL

SIEVE SIZE	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
non-NCAT-5	99.08%	77.93%	64.19%	39.97%	25.14%	15.68%	8.22%	4.54%	2.43%
non-NCAT-6	98.96%	79.61%	66.04%	42.76%	27.84%	17.75%	9.30%	5.04%	2.59%
non-NCAT-7	99.08%	79.69%	66.05%	39.76%	24.77%	15.39%	8.08%	4.60%	2.63%
non-NCAT-8	98.69%	81.77%	66.71%	43.18%	28.40%	18.15%	9.48%	5.22%	2.83%
MEAN	98.95%	79.75%	65.75%	41.42%	26.54%	16.74%	8.77%	4.85%	2.62%
STD DEV	0.2%	1.6%	1.1%	1.8%	1.8%	1.4%	0.7%	0.3%	0.2%
MEAN DIFF	-0.8%	1.4%	0.8%	0.2%	0.1%	0.2%	0.2%	0.2%	0.1%
s sub D bar	0.3%	0.3%	0.5%	0.7%	1.0%	1.0%	0.6%	0.3%	0.2%
Mean DIFF + 3.18	0.12%	2.52%	2.50%	2.51%	3.25%	3.24%	2.00%	1.19%	0.64%
Mean DIFF - 3.18	-1.68%	0.36%	-0.87%	-2.13%	-2.95%	-2.89%	-1.57%	-0.86%	-0.41%
t	-2.7599	4.2590	1.5376	0.2640	0.1508	0.1820	0.3872	0.5009	0.7109
t critical two-tail	3.1824	3.1824	3.1824	3.1824	3.1824	3.1824	3.1824	3.1824	3.1824

VALCO/ROCKY MOUNTAIN/CAS PIT:

CONTROL

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
NON NCAT-5	100.00%	75.67%	61.68%	45.32%	35.54%	26.49%	12.05%	5.00%	2.78%
NON NCAT-6	99.51%	73.90%	59.11%	43.30%	33.20%	24.21%	10.84%	4.49%	2.54%
NON NCAT-7	99.76%	75.41%	61.56%	45.86%	36.79%	27.68%	12.58%	5.29%	3.03%
NON NCAT-8	100.00%	72.81%	60.13%	44.37%	35.00%	25.71%	11.43%	4.61%	2.56%
MEAN	99.82%	74.45%	60.62%	44.71%	35.13%	26.02%	11.73%	4.85%	2.73%
STD DEV	0.2%	1.3%	1.2%	1.1%	1.5%	1.5%	0.8%	0.4%	0.2%

EXPERIMENTAL

NCAT-1	100.00%	71.69%	60.00%	43.43%	33.15%	24.23%	11.29%	4.86%	2.75%
NCAT-2	99.62%	72.94%	60.56%	45.85%	36.40%	27.19%	12.62%	5.26%	
NCAT-3	99.55%	75.29%	60.34%	44.62%	34.36%	25.03%	11.39%	4.81%	2.75%
NCAT-4	100.00%	76.69%	64.77%	48.14%	36.83%	26.80%	12.13%	5.10%	2.80%
MEAN	99.79%	74.15%	61.42%	45.51%	35.18%	25.81%	11.86%	5.01%	2.77%
STD DEV	0.2%	2.3%	2.2%	2.0%	1.7%	1.4%	0.6%	0.2%	0.0%
MEAN DIFF	-0.0258%	**********	0.7965%	0.7997%	0.0527%	-0.2101%	0.1306%	0.1604%	0.0356%
s sub D bar	0.07%	1.62%	1.46%	1.39%	1.45%	1.35%	0.68%	0.29%	0.08%
Mean DIFF + 3.18	0.19%	4.86%	5.43%	5.23%	4.67%	4.10%	2.30%	1.07%	0.30%
Mean DIFF - 3.18	-0.24%	-5.46%	-3.84%	-3.63%	-4.57%	-4.52%	-2.04%	-0.75%	-0.23%
t	-0.3823	-0.1842	0.5468	0.5747	0.0363	-0.1551	0.1918	0.5621	0.4266
t critical two-tail	3.1824	3.1824	3.1824	3.1824	3.1824	3.1824	3.1824	3.1824	3.1824

Irwin Winsor/Stute Pit:

CONTROL

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
NON NCAT-5	100.00%	80.67%	59.97%	43.01%	31.60%	22.14%	13.88%	8.29%	4.99%
NON NCAT-6	99.70%	81.64%	60.27%	44.14%	31.81%	22.03%	13.90%	8.57%	5.49%
NON NCAT-7	100.00%	75.87%	56.65%	42.17%	30.19%	20.18%	12.33%	7.46%	4.67%
NON NCAT-8	99.40%	80.37%	60.86%	44.82%	33.32%	23.51%	14.71%	8.82%	5.34%
Mean	99.78%	79.64%	59.43%	43.54%	31.73%	21.96%	13.71%	8.29%	5.12%
STD DEV	0.3%	2.6%	1.9%	1.2%	1.3%	1.4%	1.0%	0.6%	0.4%

EXPERIMENTAL

NCAT-1	99.78%	79.98%	58.65%	44.50%	33.76%	24.42%	15.79%	9.73%	6.10%
NCAT-2	99.45%	82.21%	60.11%	42.64%	30.06%	20.80%	13.37%	8.47%	5.59%
NCAT-3	100.00%	78.89%	58.50%	42.87%	31.01%	21.76%	14.02%	8.76%	5.59%
NCAT-4	100.00%	79.60%	60.78%	45.63%	33.53%	23.71%	15.34%	9.66%	6.25%
Mean	99.81%	80.17%	59.51%	43.91%	32.09%	22.67%	14.63%	9.16%	5.88%
STD DEV	0.3%	1.4%	1.1%	1.4%	1.8%	1.7%	1.1%	0.6%	0.3%
MEAN DIFF	0.0298%	0.5331%	0.0742%	0.3760%	0.3577%	0.7092%	0.9207%	0.8704%	0.7577%
s sub D bar	0.20%	0.9%	0.7%	0.6%	0.8%	0.8%	0.6%	0.3%	0.2%
Mean DIFF + 3.18	0.66%	3.34%	2.17%	2.44%	2.94%	3.18%	2.70%	1.98%	1.47%
Mean DIFF - 3.18:	-0.60%	-2.28%	-2.02%	-1.69%	-2.23%	-1.76%	-0.86%	-0.24%	0.05%
t	0.1509	0.6041	0.1129	0.5791	0.4401	0.9133	1.646	2.5009	3.4088
t critical two-tail	3.1824	3.1824	3.1824	3.1824	3.1824	3.1824	3.1824	3.1824	3.1824

MONK PIT:

EXPERIMENTAL

SIEVE SIZE	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
NCAT-1	99.47%	82.21%	62.56%	38.03%	25.14%	17.44%	11.11%	6.52%	3.17%
NCAT-2	98.53%	83.61%	65.02%	42.68%	30.80%	22.54%	14.76%	9.57%	7.91%
NCAT-3	99.16%	81.68%	64.78%	43.70%	31.90%	23.41%	14.84%	7.91%	3.14%
NCAT-4	100.00%	80.47%	64.06%	42.26%	29.88%	21.37%	13.44%	7.38%	3.15%
MEAN	99.29%	81.99%	64.10%	41.67%	29.43%	21.19%	13.53%	7.85%	4.34%
STD DEV	0.6%	1.3%	1.1%	2.5%	3.0%	2.6%	1.7%	1.3%	2.4%

CONTROL

SIEVE SIZE	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
NON NCAT-5	99.50%	80.09%	62.74%	41.40%	28.90%	20.54%	13.15%	7.66%	3.72%
NON NCAT-6	99.24%	78.83%	63.42%	43.15%	31.60%	23.12%	14.77%	8.27%	3.63%

NON NCAT-7	98.59%	82.73%	66.32%	42.41%	28.37%	19.66%	12.50%	7.28%	3.55%
NON NCAT-8	99.50%	79.58%	63.54%	42.81%	30.48%	21.81%	13.73%	7.66%	3.23%
MEAN	99.21%	80.31%	64.01%	42.44%	29.84%	21.28%	13.54%	7.72%	3.53%
STD DEV	0.4%	1.7%	1.6%	0.8%	1.5%	1.5%	1.0%	0.4%	0.2%
MEAN DIFF	0.08%	1.68%	0.10%	-0.77%	-0.41%	-0.10%	-0.00%	0.13%	0.81%
s sub D bar	0.30%	1.22%	0.66%	0.96%	1.50%	1.42%	0.90%	0.53%	1.16%
Mean DIFF + 3.18	1.03%	5.57%	2.19%	2.29%	4.36%	4.42%	2.86%	1.83%	4.49%
Mean DIFF - 3.18;	-0.86%	-2.20%	-2.00%	-3.84%	-5.17%	-4.62%	-2.87%	-1.57%	-2.88%
t	0.2835	1.3797	0.1465	-0.8018	-0.2719	-0.0694	-0.0025	0.2444	0.6962
P(T<=t) two-tail	3.1824	3.1824	3.1824	3.1824	3.1824	3.1824	3.1824	3.1824	3.1824

PAGOSA TROUT LAKES

CONTROL

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
Non NCAT-1	99.74%	73.50%	46.45%	33.26%	22.75%	16.09%	11.09%	7.57%	5.33%
Non NCAT-2	99.80%	76.99%	54.75%	41.27%	29.60%	21.25%	14.52%	9.64%	6.63%
Non NCAT-3	99.46%	72.27%	47.95%	32.01%	22.27%	15.76%	10.59%	6.97%	4.74%
Non NCAT-7	99.79%	79.37%	56.00%	38.61%	27.73%	20.00%	13.62%	8.91%	6.34%
Non NCAT-8	100.00%	75.03%	50.12%	34.20%	24.37%	17.49%	11.94%	7.99%	5.64%
MEAN	99.76%	75.43%	51.05%	35.87%	25.34%	18.12%	12.35%	8.22%	5.74%
STD DEV	0.2%	2.8%	4.2%	3.9%	3.2%	2.4%	1.7%	1.1%	0.8%

EXPERIMENTAL

NCAT-4	100.00%	76.34%	52.40%	35.85%	25.35%	18.28%	12.53%	8.36%	5.83%
NCAT-5	100.00%	74.63%	50.46%	37.59%	27.07%	19.71%	13.81%	9.44%	6.61%
NCAT-6	100.00%	75.65%	51.00%	36.76%	25.63%	18.29%	12.65%	8.59%	5.94%
MEAN	100.00%	0.75538	0.51287	0.367354	0.260173	0.1876162	0.129988	0.087975	0.061266
STD DEV	0.0%	0.9%	1.0%	0.9%	0.9%	0.8%	0.7%	0.6%	0.4%
MEAN DIFF	0.2404%	0.1059%	0.2332%	0.8630%	0.6749%	0.6446%	0.6469%	0.5799%	0.3885%

S sub d bar = Sample std./ sqrt (n)

S sub d bar = mean diff./ t

t = mean diff./ S sub d bar

95 % Confidence limits = Mean diff. +/- 3.1824 * S sub d bar

n = 4, # of differences

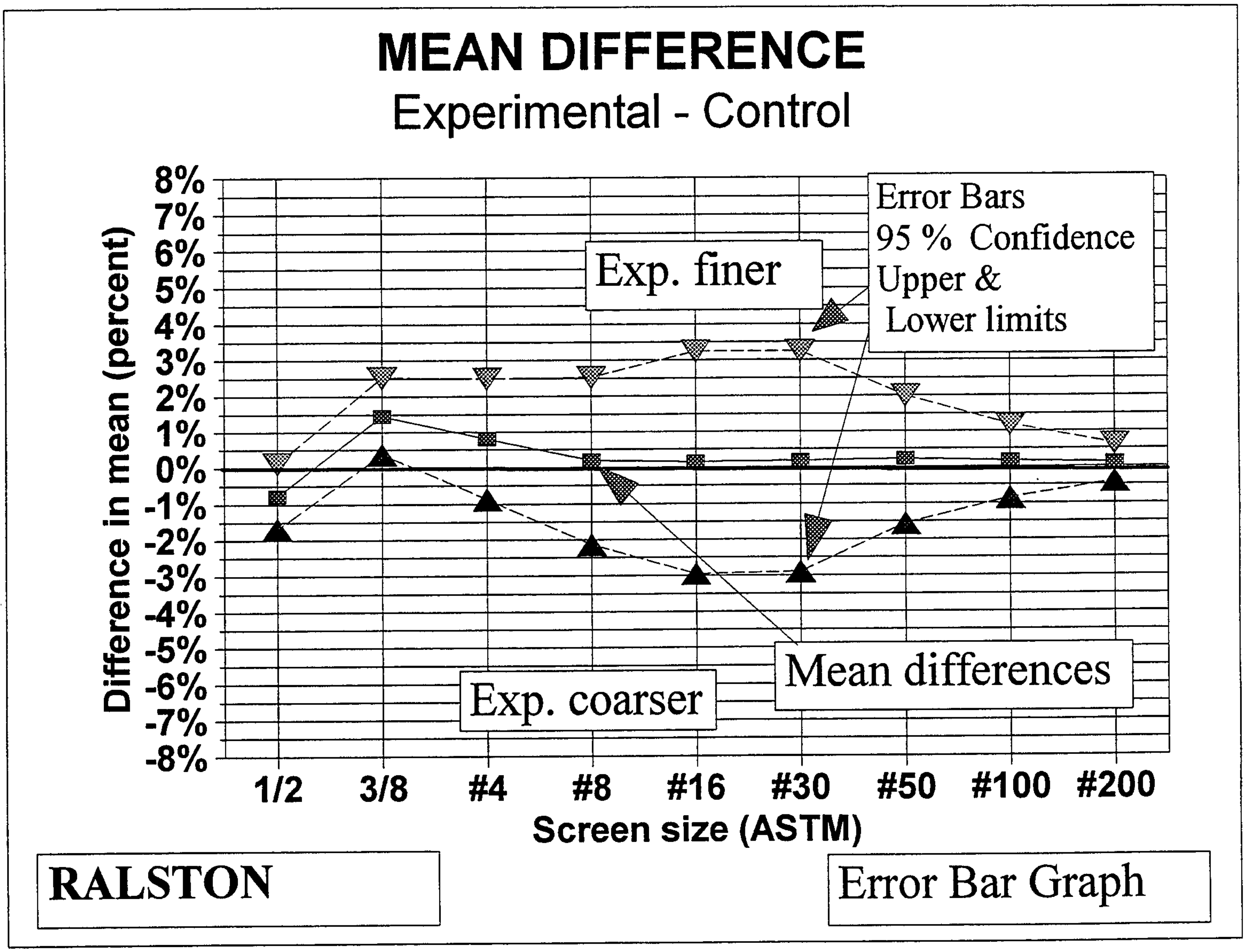
APPENDIX B

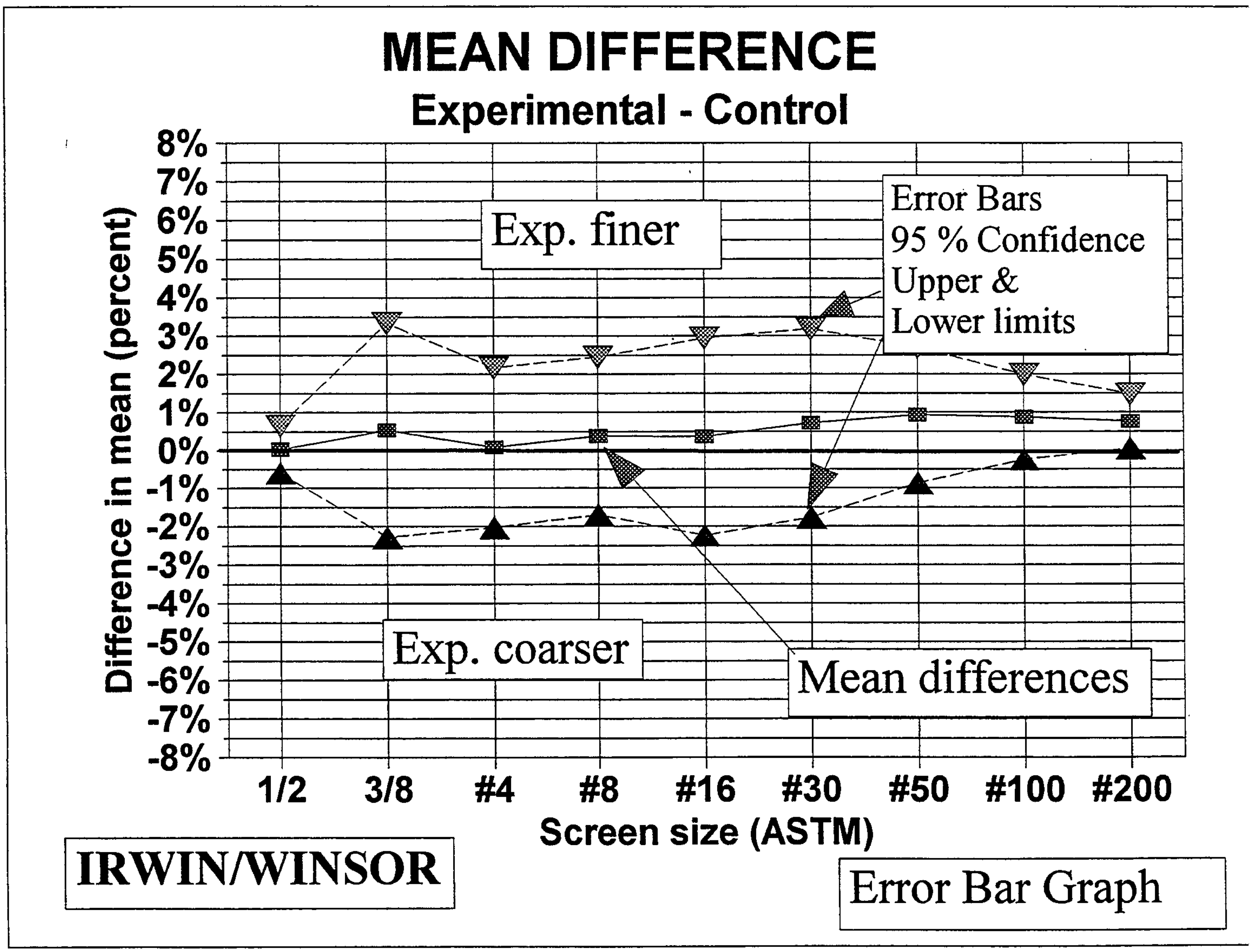
* Confidence Interval Figures For Each Aggregate Source

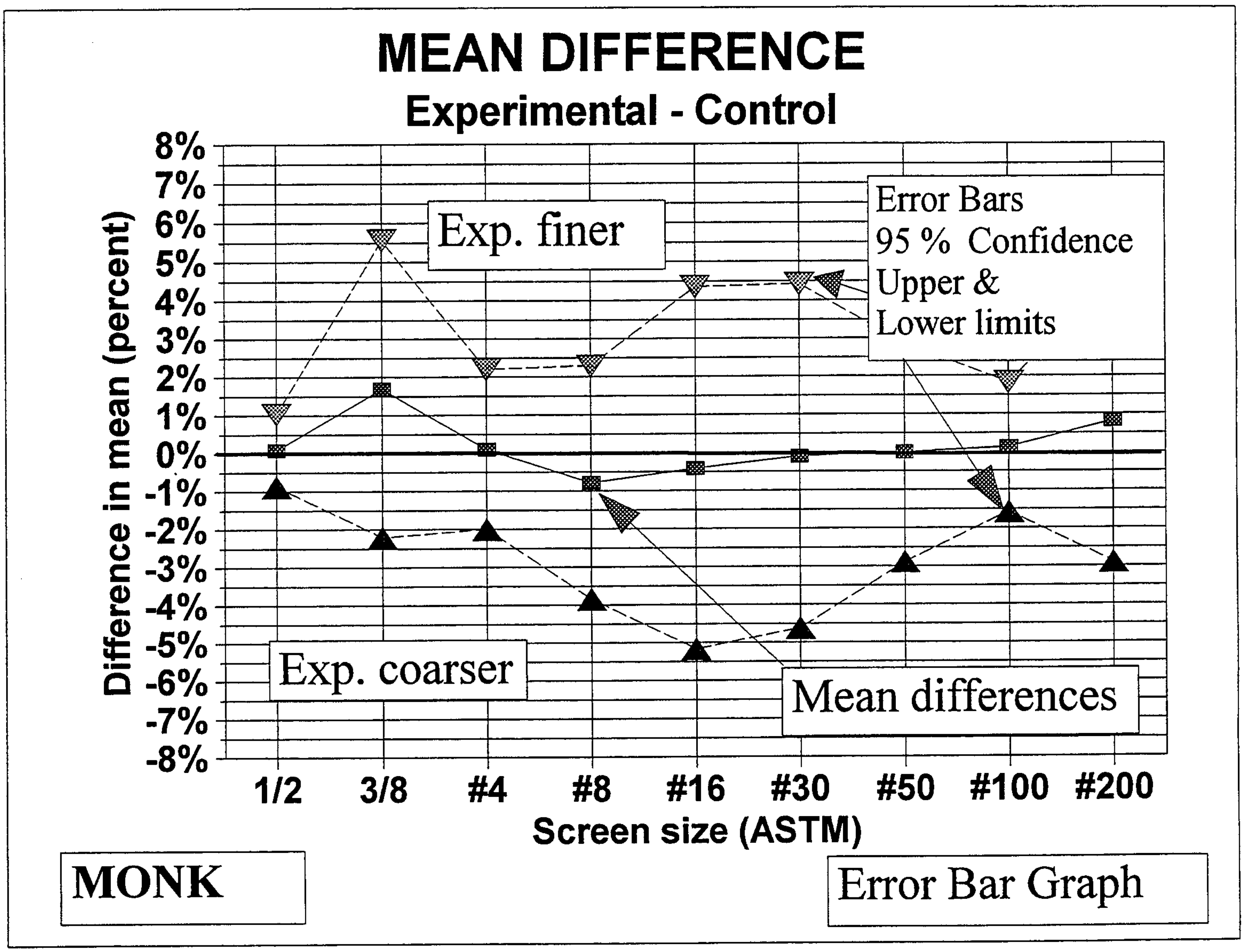
* Data Used to Calculate the 95 % Confidence Intervals

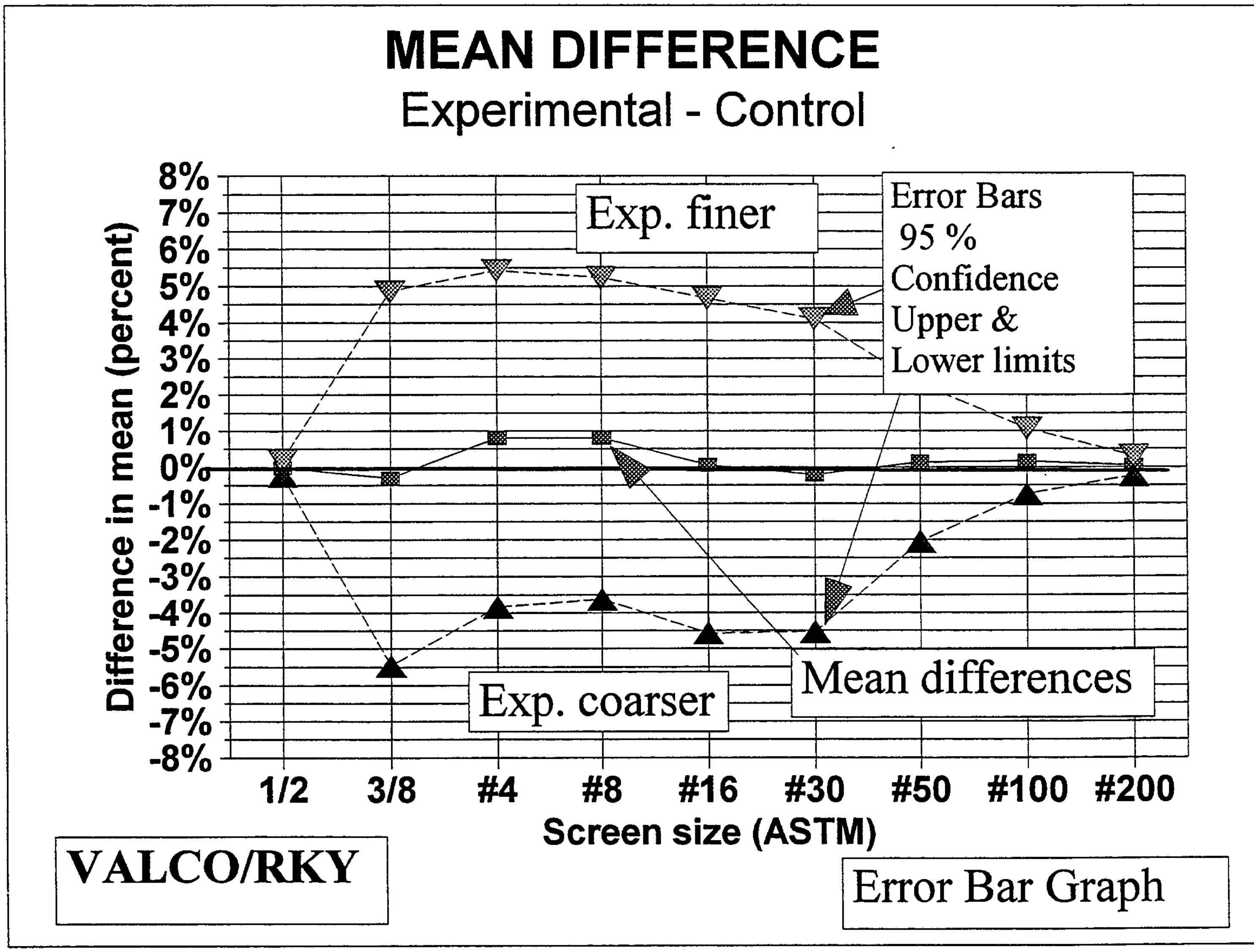
* Data From the Students t-Test

* Gradation Results From Each Aggregate Source


MEAN DIFFERENCE
Experimental - Control
Difference in mean (percent)
8%
7%
6%
5%
4%
3%
2%
1%
0%
-1%
-2%
-3%
-4%
-5%
-6%
-7%
-8%
Exp. finer
Error Bars
95 % Confidence
Upper &
Lower limits
Mean differences
Exp. coarser
1/2
3/8
#4
#8
#16
#30
#50
#100
#200
Screen size (ASTM)
RALSTON
Error Bar Graph


MEAN DIFFERENCE
Experimental - Control
8%
7%
6%
5%
4%
3%
2%
1%
0%
-1%
-2%
-3%
-4%
-5%
-6%
-7%
-8%
Difference in mean (percent)
Exp. finer
Error Bars
95 % Confidence
Upper &
Lower limits
Exp. coarser
Mean differences
1/2
3/8
#4
#8
#16
#30
#50
#100
#200
Screen size (ASTM)
IRWIN/WINSOR
Error Bar Graph


MEAN DIFFERENCE
Experimental - Control
Difference in mean (percent)
8%
7%
6%
5%
4%
3%
2%
1%
0%
-1%
-2%
-3%
-4%
-5%
-6%
-7%
-8%
Exp. finer
Error Bars
95 % Confidence
Upper &
Lower limits
Exp. coarser
Mean differences
1/2
3/8
#4
#8
#16
#30
#50
#100
#200
Screen size (ASTM)
MONK
Error Bar Graph



MEAN DIFFERENCE
Experimental - Control
Exp. finer
Error Bars
95 %
Confidence
Upper &
Lower limits
8%
7%
6%
5%
4%
3%
2%
1%
0%
-1%
-2%
-3%
-4%
-5%
-6%
-7%
-8%
Difference in mean (percent)
Mean differences
Exp. coarser
1/2
3/8
#4
#8
#16
#30
#50
#100
#200
Screen size (ASTM)
VALCO/RKY
Error Bar Graph

FRANCISCOTTI

1/2 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	*Variable 2*
Mean	0.996571615532207	0.998279004593418
Variance	7.01361800214759E-06	4.25007356707682E-06
Observations	4	4
Pearson Correlation	-0.162551178281695	
Pooled Variance	5.63184578460 44E-06	
Hypothesized Mean Difference	0	
df	3	
t	-0.94568411494538	
P(T<=t) one-tail	0.207038447871417	
t Critical one-tail	2.3533634343976	
P(T<=t) two-tail	0.414076895742834	
t Critical two-tail	3.18244630501062	

3/8 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	*Variable 2*
Mean	0.705212855172953	0.696401229010712
Variance	6.30737551868694E-05	0.000221684436618976
Observations	4	4
Pearson Correlation	-0.643644645092493	
Pooled Variance	0.000142379095902816	
Hypothesized Mean Difference	0	
df	3	
t	0.843056745071967	
P(T<=t) one-tail	0.230552844460898	
t Critical one-tail	2.3533634343976	
P(T<=t) two-tail	0.461105688921795	
t Critical two-tail	3.18244630501062	

#4

t-Test: Paired Two-Sample for Means

	Variable 1	*Variable 2*
Mean	0.458362137793419	0.44668143058789
Variance	3.52620651336502E-05	0.00043060127318459
Observations	4	4
Pearson Correlation	-0.321795041909436	
Pooled Variance	0.000232931669159104	
Hypothesized Mean Difference	0	
df	3	
t	1.00053848674475	
P(T<=t) one-tail	0.195389808274356	
t Critical one-tail	2.3533634343976	
P(T<=t) two-tail	0.390779616548712	
t Critical two-tail	3.18244630501062	

#8

t-Test: Paired Two-Sample for Means

	Variable 1	*Variable 2*
Mean	0.336057513064896	0.330680000615908
Variance	2.8573177522128E-05	0.000532481043717379
Observations	4	4
Pearson Correlation	0.870732286698803	
Pooled Variance	0.000280527110619772	
Hypothesized Mean Difference	0	
df	3	
t	0.577986260532656	
P(T<=t) one-tail	0.301901347739717	
t Critical one-tail	2.3533634343976	
P(T<=t) two-tail	0.603802695479434	
t Critical two-tail	3.18244630501062	

#16

t-Test: Paired Two-Sample for Means

	Variable 1	*Variable 2*
Mean	0.247896848247481	0.247149438820667
Variance	4.35655882272443E-05	0.000513064796500453
Observations	4	4
Pearson Correlation	0.898451619703346	
Pooled Variance	0.000278315192363843	
Hypothesized Mean Difference	0	
df	3	
t	0.0880856430137138	
P(T<=t) one-tail	0.467679587721309	
t Critical one-tail	2.3533634343976	
P(T<=t) two-tail	0.935359175442618	
t Critical two-tail	3.18244630501062	

#30

t-Test: Paired Two-Sample for Means

	Variable 1	*Variable 2*
Mean	0.17361325	0.17308811
Variance	3.0802E-05	0.00034895
Observations	4	4
Pearson Correlation	0.66341098	
Pooled Variance	0.00018987	
Hypothesized Mean Difference	0	
df	3	
t	0.06748688	
P(T<=t) one-tail	0.47522009	
t Critical one-tail	2.35336343	
P(T<=t) two-tail	0.95044019	
t Critical two-tail	3.18244631	

#50

t-Test: Paired Two-Sample for Means

	Variable 1	*Variable 2*
Mean	0.11317147	0.11158303
Variance	1.7116E-05	0.0001607
Observations	4	4
Pearson Correlation	0.49479551	
Pooled Variance	8.8909E-05	
Hypothesized Mean Difference	0	
df	3	
t	0.28311106	
P(T<=t) one-tail	0.39775177	
t Critical one-tail	2.35336343	
P(T<=t) two-tail	0.79550353	
t Critical two-tail	3.18244631	

#100

t-Test: Paired Two-Sample for Means

	Variable 1	*Variable 2*
Mean	0.07295878	0.0709209
Variance	6.3456E-06	6.1129E-05
Observations	4	4
Pearson Correlation	0.54348712	
Pooled Variance	3.3737E-05	
Hypothesized Mean Difference	0	
df	3	
t	0.60050419	
P(T<=t) one-tail	0.2952529	
t Critical one-tail	2.35336343	
P(T<=t) two-tail	0.5905058	
t Critical two-tail	3.18244631	

#200

t-Test: Paired Two-Sample for Means

	Variable 1	*Variable 2*
Mean	0.04602038	0.04383227
Variance	3.3147E-06	2.1637E-05
Observations	4	4
Pearson Correlation	0.70093696	
Pooled Variance	1.2476E-05	
Hypothesized Mean Difference	0	
df	3	
t	1.21006399	
P(T<=t) one-tail	0.15645147	
t Critical one-tail	2.35336343	
P(T<=t) two-tail	0.31290293	
t Critical two-tail	3.18244631	

RALSTON

1/2 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	*Variable 2*
Mean	0.98174771	0.98954466
Variance	2.254E-05	3.346E-06
Observations	4	4
Pearson Correlation	-0.3474716	
Pooled Variance	1.294E-05	
Hypothesized Mean Difference	0	
df	3	
t	-2.759911	
P(T<=t) one-tail	0.03507877	
t Critical one-tail	2.35336343	
P(T<=t) two-tail	0.07015754	
t Critical two-tail	3.18244631	

3/8 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	*Variable 2*
Mean	0.81187931	0.79747499
Variance	0.00014316	0.00024654
Observations	4	4
Pearson Correlation	0.91539077	
Pooled Variance	0.00019485	
Hypothesized Mean Difference	0	
df	3	
t	4.25910261	
P(T<=t) one-tail	0.01186793	
t Critical one-tail	2.35336343	
P(T<=t) two-tail	0.02373587	
t Critical two-tail	3.18244631	

4 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	*Variable 2*
Mean	*0.66559565*	*0.65746052*
Variance	0.00028672	0.00011771
Observations	4	4
Pearson Correlation	0.7959884	
Pooled Variance	0.00020222	
Hypothesized Mean Difference	0	
df	3	
t	1.53762578	
P(T<=t) one-tail	0.11087201	
t Critical one-tail	2.35336343	
P(T<=t) two-tail	0.22174403	
t Critical two-tail	3.18244631	

8 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	*Variable 2*
Mean	*0.41610039*	*0.41417486*
Variance	0.00021474	0.00032428
Observations	4	4
Pearson Correlation	0.61819305	
Pooled Variance	0.00026951	
Hypothesized Mean Difference	0	
df	3	
t	0.26402279	
P(T<=t) one-tail	0.40443023	
t Critical one-tail	2.35336343	
P(T<=t) two-tail	0.80886046	
t Critical two-tail	3.18244631	

16 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	*Variable 2*
Mean	*0.266844164264627*	*0.265375743859607*
Variance	0.000219484107466921	0.000341605894113272
Observations	4	4
Pearson Correlation	0.331600138833067	
Pooled Variance	0.00028054500079011	
Hypothesized Mean Difference	0	
df	3	
t	0.15075737952589	
P(T<=t) one-tail	0.444866700356124	
t Critical one-tail	2.3533634343976	
P(T<=t) two-tail	0.889733400712248	
t Critical two-tail	3.18244630501062	

30 SIEVE

t-Test Two Sample Assuming Equal Variance

	Variable 1	*Variable 2*
Mean	*0.169186751435183*	*0.167432700899705*
Variance	0.000172927756376044	0.000198533563873232
Observations	4	4
Pooled Variance	0.000185730660124635	
Hypothesized Mean Difference	0	
df	6	
t	0.182018402418259	
P(T<=t) one-tail	0.430781054561881	
t Critical one-tail	1.94318028004358	
P(T<=t) two-tail	0.861562109123762	
t Critical two-tail	2.44691185086496	

#50 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	*Variable 2*
Mean	*0.0898567268253932*	*0.0876883207783596*
Variance	7.5475181521397E-05	5.2074692428217E-05
Observations	4	4
Pearson Correlation	0.0170905978089687	
Pooled Variance	6.3774936974808E-05	
Hypothesized Mean Difference	0	
df	3	
t	0.387266354760011	
P(T<=t) one-tail	0.362199404648422	
t Critical one-tail	2.3533634343976	
P(T<=t) two-tail	0.724398809296844	
t Critical two-tail	3.18244630501062	

#100 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	*Variable 2*
Mean	*0.0501330266025405*	*0.0485190478493572*
Variance	2.5438105040976E-05	1.1158010520335E-05
Observations	4	4
Pearson Correlation	-0.104866731527322	
Pooled Variance	1.8298057780655E-05	
Hypothesized Mean Difference	0	
df	3	
t	0.509560059939925	
P(T<=t) one-tail	0.322738791213532	
t Critical one-tail	2.3533634343976	
P(T<=t) two-tail	0.645477582427065	
t Critical two-tail	3.18244630501062	

200 SIEVE

t-Test: Paired Two-Sample for Means

t-Test: Paired Two-Sample for Means	*Variable 1*	*Variable 2*
Mean	*Variable 1*	*Variable 2*
Mean	0.0273632896500255	0.0261979987726052
Variance	7.7899446355805E-06	2.71984951585E-06
Observations	4	4
Pearson Correlation	-0.02557034075969	
Pooled Variance	5.2548970757151E-06	
Hypothesized Mean Difference	0	
df	3	
t	0.710979718642712	
P(T<=t) one-tail	0.264194679803404	
t Critical one-tail	2.3533634343976	
P(T<=t) two-tail	0.528389359606808	
t Critical two-tail	3.18244630501062	

IRWIN/WINSOR/STUTE PIT

1/2 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.9980638	0.9977661
Variance	6.821E-06	8.148E-06
Observations	4	4
Pearson Correlation	-0.039627	
Pooled Variance	7.485E-06	
Hypothesized Mean Difference	0	
df	3	
t	0.1509246	
P(T<=t) one-tail	0.4448061	
t Critical one-tail	2.3533634	
P(T<=t) two-tail	0.8896123	
t Critical two-tail	3.1824463	

3/8 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.8017083	0.7963775
Variance	0.0002043	0.0006591
Observations	4	4
Pearson Correlation	0.7520273	
Pooled Variance	0.0004317	
Hypothesized Mean Difference	0	
df	3	
t	0.6041332	
P(T<=t) one-tail	0.2941913	
t Critical one-tail	2.3533634	
P(T<=t) two-tail	0.5883826	
t Critical two-tail	3.1824463	

4 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.5950921	0.5943496
Variance	0.0001241	0.0003589
Observations	4	4
Pearson Correlation	0.7347129	
Pooled Variance	0.0002415	
Hypothesized Mean Difference	0	
df	3	
t	0.1129463	
P(T<=t) one-tail	0.4586035	
t Critical one-tail	2.3533634	
P(T<=t) two-tail	0.9172071	
t Critical two-tail	3.1824463	

#8 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.4391126	0.4353525
Variance	0.0001995	0.0001395
Observations	4	4
Pearson Correlation	0.510758	
Pooled Variance	0.0001695	
Hypothesized Mean Difference	0	
df	3	
t	0.5791473	
P(T<=t) one-tail	0.301556	
t Critical one-tail	2.3533634	
P(T<=t) two-tail	0.6031119	
t Critical two-tail	3.1824463	

#16 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.3208848	0.3173074
Variance	0.0003397	0.0001634
Observations	4	4
Pearson Correlation	0.5068478	
Pooled Variance	0.0002515	
Hypothesized Mean Difference	0	
df	3	
t	0.4401451	
P(T<=t) one-tail	0.3448067	
t Critical one-tail	2.3533634	
P(T<=t) two-tail	0.6896135	
t Critical two-tail	3.1824463	

30 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.2267257	0.2196333
Variance	0.0002817	0.0001871
Observations	4	4
Pearson Correlation	0.4956221	
Pooled Variance	0.0002344	
Hypothesized Mean Difference	0	
df	3	
t	0.9132575	
P(T<=t) one-tail	0.2142233	
t Critical one-tail	2.3533634	
P(T<=t) two-tail	0.4284465	
t Critical two-tail	3.1824463	

50 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.1462659	0.1370587
Variance	0.0001272	9.905E-05
Observations	4	4
Pearson Correlation	0.449435	
Pooled Variance	0.0001131	
Hypothesized Mean Difference	0	
df	3	
t	1.6445927	
P(T<=t) one-tail	0.0993011	
t Critical one-tail	2.3533634	
P(T<=t) two-tail	0.1986023	
t Critical two-tail	3.1824463	

100 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.091571	0.0828668
Variance	4.057E-05	3.481E-05
Observations	4	4
Pearson Correlation	0.3582937	
Pooled Variance	3.769E-05	
Hypothesized Mean Difference	0	
df	3	
t	2.5008765	
P(T<=t) one-tail	0.0438195	
t Critical one-tail	2.3533634	
P(T<=t) two-tail	0.0876389	
t Critical two-tail	3.1824463	

200 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.0588157	0.0512384
Variance	1.166E-05	1.343E-05
Observations	4	4
Pearson Correlation	0.2128736	
Pooled Variance	1.255E-05	
Hypothesized Mean Difference	0	
df	3	
t	3.4088882	
P(T<=t) one-tail	0.0210925	
t Critical one-tail	2.3533634	
P(T<=t) two-tail	0.0421851	
t Critical two-tail	3.1824463	

MONK

1/2 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.99291102	0.9920696
Variance	3.7621E-05	1.8368E-05
Observations	4	4
Pearson Correlation	0.39744909	
Pooled Variance	2.8094E-05	
Hypothesized Mean Difference	0	
df	3	
t	0.28349248	
P(T<=t) one-tail	0.39761879	
t Critical one-tail	2.35336343	
P(T<=t) two-tail	0.79523758	
t Critical two-tail	3.18244631	

3/8 sieve

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.81992515	0.80308183
Variance	0.00016979	0.00028775
Observations	4	4
Pearson Correlation	-0.31356015	
Pooled Variance	0.00022877	
Hypothesized Mean Difference	0	
df	3	
t	1.37967217	
P(T<=t) one-tail	0.13076855	
t Critical one-tail	2.35336343	
P(T<=t) two-tail	0.26163711	
t Critical two-tail	3.18244631	

#4

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.64103271	0.6400685
Variance	0.0001221	0.00025119
Observations	4	4
Pearson Correlation	0.57105776	
Pooled Variance	0.00018665	
Hypothesized Mean Difference	0	
df	3	
t	0.14649968	
P(T<=t) one-tail	0.44640883	
t Critical one-tail	2.35336343	
P(T<=t) two-tail	0.89281767	
t Critical two-tail	3.18244631	

#8

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.416699	0.42441763
Variance	0.00062412	5.7345E-05
Observations	4	4
Pearson Correlation	0.8212687	
Pooled Variance	0.00034073	
Hypothesized Mean Difference	0	
df	3	
t	-0.80175665	
P(T<=t) one-tail	0.24066124	
t Critical one-tail	2.35336343	
P(T<=t) two-tail	0.48132248	
t Critical two-tail	3.18244631	

16 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.294305369553428	0.298374462583359
Variance	0.000885608479368379	0.000217613877866028
Observations	4	4
Pearson Correlation	0.236087262272219	
Pooled Variance	0.000551611178617224	
Hypothesized Mean Difference	0	
df	3	
t	-0.271887135585949	
P(T<=t) one-tail	0.401673226979669	
t Critical one-tail	2.3533634343976	
P(T<=t) two-tail	0.803346453959337	
t Critical two-tail	3.18244630501062	

30 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.211860607852394	0.212846106462435
Variance	0.000695111077372672	0.000228111019201636
Observations	4	4
Pearson Correlation	0.148236875301085	
Pooled Variance	0.000461611048287148	
Hypothesized Mean Difference	0	
df	3	
t	-0.0694613398377643	
P(T<=t) one-tail	0.474496638484124	
t Critical one-tail	2.3533634343976	
P(T<=t) two-tail	0.948993276968247	
t Critical two-tail	3.18244630501062	

60 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.135347475584374	0.135369994990134
Variance	0.000302283321688432	9.3011647648O9E-05
Observations	4	4
Pearson Correlation	0.213952464794077	
Pooled Variance	0.000197647432266202	
Hypothesized Mean Difference	0	
df	3	
t	-0.00250391617219616	
P(T<=t) one-tail	0.499079680390799	
t Critical one-tail	2.3533634343976	
P(T<=t) two-tail	0.998159360781598	
t Critical two-tail	3.18244630501062	

100 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.0784615175207884	0.0771582364751656
Variance	0.000164847195124347	1.66353304125 91E-05
Observations	4	4
Pearson Correlation	0.646981793223401	
Pooled Variance	9.07412627684686E-05	
Hypothesized Mean Difference	0	
df	3	
t	0.244425415661785	
P(T<=t) one-tail	0.411332564615251	
t Critical one-tail	2.3533634343976	
P(T<=t) two-tail	0.822665129230502	
t Critical two-tail	3.18244630501062	

200 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.0434130554004954	0.0353457378191753
Variance	0.000564552534702789	4.5899128031601E-06
Observations	4	4
Pearson Correlation	0.314661444365681	
Pooled Variance	0.000284571223752975	
Hypothesized Mean Difference	0	
df	3	
t	0.696191405735769	
P(T<=t) one-tail	0.268199448921774	
t Critical one-tail	2.3533634343976	
P(T<=t) two-tail	0.536398897843548	
t Critical two-tail	3.18244630501062	

VALCO/ROCKY MOUNTAIN/CAS PIT

1/2 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	*0.9979335*	*0.9981915*
Variance	5.786E-06	5.388E-06
Observations	4	4
Pearson Correlation	0.8374793	
Pooled Variance	5.587E-06	
Hypothesized Mean Difference	0	
df	3	
t	-0.3823281	
P(T<=t) one-tail	0.3638478	
t Critical one-tail	2.3533634	
P(T<=t) two-tail	0.7276955	
t Critical two-tail	3.1824463	

3/8 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	*0.741516*	*0.7444998*
Variance	0.0005089	0.0001801
Observations	4	4
Pearson Correlation	-0.5963528	
Pooled Variance	0.0003445	
Hypothesized Mean Difference	0	
df	3	
t	-0.1842071	
P(T<=t) one-tail	0.4327996	
t Critical one-tail	2.3533634	
P(T<=t) two-tail	0.8655992	
t Critical two-tail	3.1824463	

#4 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	*0.8141669*	*0.8062019*
Variance	0.0005058	0.0001513
Observations	4	4
Pearson Correlation	-0.3460494	
Pooled Variance	0.0003286	
Hypothesized Mean Difference	0	
df	3	
t	0.5468147	
P(T<=t) one-tail	0.3112771	
t Critical one-tail	2.3533634	
P(T<=t) two-tail	0.6225541	
t Critical two-tail	3.1824463	

8 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	*0.4551052*	*0.4471086*
Variance	0.0004039	0.0001267
Observations	4	4
Pearson Correlation	-0.53873	
Pooled Variance	0.0002653	
Hypothesized Mean Difference	0	
df	3	
t	0.5747119	
P(T<=t) one-tail	0.3028769	
t Critical one-tail	2.3533634	
P(T<=t) two-tail	0.6057537	
t Critical two-tail	3.1824463	

16 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	*0.3518497*	*0.3513226*
Variance	0.0002998	0.0002221
Observations	4	4
Pearson Correlation	-0.6148216	
Pooled Variance	0.0002609	
Hypothesized Mean Difference	0	
df	3	
t	0.0363915	
P(T<=t) one-tail	0.4866281	
t Critical one-tail	2.3533634	
P(T<=t) two-tail	0.9732563	
t Critical two-tail	3.1824463	

30 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	*0.2581033*	*0.2602045*
Variance	0.0001999	0.0002112
Observations	4	4
Pearson Correlation	-0.7847108	
Pooled Variance	0.0002056	
Hypothesized Mean Difference	0	
df	3	
t	-0.1551552	
P(T<=t) one-tail	0.4432752	
t Critical one-tail	2.3533634	
P(T<=t) two-tail	0.8865504	
t Critical two-tail	3.1824463	

50 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.1185588	0.1172532
Variance	3.976E-05	5.672E-05
Observations	4	4
Pearson Correlation	-0.9363357	
Pooled Variance	4.824E-05	
Hypothesized Mean Difference	0	
df	3	
t	0.191764	
P(T<=t) one-tail	0.4300863	
t Critical one-tail	2.3533634	
P(T<=t) two-tail	0.8601727	
t Critical two-tail	3.1824463	

100 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.0500736	0.0484693
Variance	4.423E-06	1.339E-05
Observations	4	4
Pearson Correlation	-0.9593147	
Pooled Variance	8.906E-06	
Hypothesized Mean Difference	0	
df	3	
t	0.5621059	
P(T<=t) one-tail	0.3066531	
t Critical one-tail	2.3533634	
P(T<=t) two-tail	0.6133061	
t Critical two-tail	3.1824463	

200 SIEVE

t-Test: Paired Two-Sample for Means

	Variable 1	Variable 2
Mean	0.0278792	0.0273064
Variance	2.438E-07	5.2E-06
Observations	4	4
Pearson Correlation	-0.7852009	
Pooled Variance	2.722E-06	
Hypothesized Mean Difference	0	
df	3	
t	0.4266037	
P(T<=t) one-tail	0.3492147	
t Critical one-tail	2.3533634	
P(T<=t) two-tail	0.6984294	
t Critical two-tail	3.1824463	

MONK MIX

GRADATION COMPARISON USING THE NCAT OVEN
TABLE B REPRESENTS THE GRADATION OF THE AGGREGATE WITH NO ASPHALT ADDED

TABLE A REPRESENTS THE GRADATION OF THE AGGREGATE AFTER ASPHALT WAS ADDED AND BURNT OFF INSIDE THE NCAT OVEN

TABLE A

1A

AGGREGATE , LIME ADDED

Gradation X
11-01-95

Lab # NCAT MONK-1

Sieve	Weight ret each sieve	Percent passing each sieve size	
1 1/2			
1		100.00%	
1/2	6.1	99.47%	correct gradation
3/8	199.8	82.21%	
#4	227.4	62.56%	
#8	283.9	38.03%	
#16	149.2	25.14%	
#30	89.2	17.44%	
#50	73.2	11.11%	
#100	53.1	6.52%	
#200	38.8	3.17%	
-#200	3		
-200 wast	33.7		
Total	1157.4		

Gradation X
11-01-95

Lab # NCAT MONK-2

Sieve	Weight ret each sieve	Percent passing each sieve size	
1 1/2			
1		100.00%	
1/2	17.6	98.53%	correct gradation
3/8	178.3	83.61%	
#4	222.3	65.02%	
#8	267	42.68%	
#16	142	30.80%	
#30	98.8	22.54%	
#50	93	14.76%	
#100	62	9.57%	
#200	19.9	7.91%	
-#200	1.2		
-200 wast	83.3	????	
Total	1195.4		

Gradation X
11-01-95

Lab # NCAT MONK-3

Sieve	Weight ret each sieve	Percent passing each sieve size	
1 1/2			
1		100.00%	
1/2	10.8	99.16%	correct gradation
3/8	225.8	81.68%	
#4	218.3	64.78%	
#8	272.2	43.70%	
#16	152.4	31.90%	
#30	109.7	23.41%	
#50	110.7	14.84%	
#100	89.4	7.91%	
#200	61.6	3.14%	
-#200	3		
-200 wast	37.6		
Total	1291.5		

Gradation X
11-01-95

Lab # NCAT MONK-4

Sieve	Weight ret each sieve	Percent passing each sieve size	
1 1/2			
1		100.00%	correct gradation
1/2		100.00%	
3/8	251.5	80.47%	
#4	211.3	64.06%	
#8	280.6	42.26%	
#16	159.5	29.88%	
#30	109.6	21.37%	
#50	102.1	13.44%	
#100	78	7.38%	
#200	54.5	3.15%	
-#200	4.2		
-200 wast	36.3		
Total	1267.6		

TABLE B

1B

X

Gradation Analysis
11-01-95

Lab # NON NCA MONK-5

Sieve	Weight ret each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2	6.2	99.50%
3/8	241.9	80.09%
#4	216.3	62.74%
#8	266	41.40%
#16	155.8	28.90%
#30	104.2	20.54%
#50	92.1	13.15%
#100	68.4	7.66%
#200	49.1	3.72%
-#200	2.9	
-200 wast	43.5	
Total	1246.4	

Gradation Analysis
11-01-95

Lab # NON NCA MONK-6

Sieve	Weight ret each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2	9.8	99.24%
3/8	262.2	78.83%
#4	196	63.42%
#8	260.6	43.19%
#16	148.4	31.80%
#30	108.9	23.12%
#50	107.3	14.77%
#100	83.6	8.27%
#200	59.5	3.63%
-#200	4.2	
-200 wast	42.6	
Total	1284.9	

Gradation Analysis
11-01-95

Lab # NON NCA MONK-7

Sieve	Weight ret each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2	17.3	98.59%
3/8	194.8	82.73%
#4	201.5	66.32%
#8	293.7	42.41%
#16	172.4	28.37%
#30	107	19.66%
#50	88	12.50%
#100	64.1	7.28%
#200	45.8	3.55%
-#200	3.3	
-200 wast	40.3	
Total	1228.2	

Gradation Analysis
11-01-95

Lab # NON NCA MONK-8

Sieve	Weight ret each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2	6.7	99.50%
3/8	265.1	79.58%
#4	213.4	63.54%
#8	275.9	42.81%
#16	164.1	30.48%
#30	115.3	21.81%
#50	107.6	13.73%
#100	80.8	7.66%
#200	58.9	3.23%
-#200	4.6	
-200 wast	38.4	
Total	1330.8	

Ralston MIX

GRADATION COMPARISON USING THE NCAT OVEN

TABLE A REPRESENTS THE GRADATION OF THE AGGREGATE WITH NO ASPHALT ADDED

TABLE B REPRESENTS THE GRADATION OF THE AGGREGATE AFTER ASPHALT WAS ADDED AND BURNT OFF INSIDE THE NCAT OVEN

TABLE A

1A

AGGREGATE , LIME ADDED

Gradation X, 10-26-95 — Lab # non-NCAT Ral–5

Sieve	Weight ret each sieve	Percent passing each sieve size	
1 1/2			
1		100.00%	correct gradation
1/2	11.7	99.08%	
3/8	269	77.93%	
#4	174.8	64.19%	
#8	306	39.97%	
#16	188.7	25.14%	
#30	120.3	15.68%	
#50	94.9	8.22%	
#100	46.7	4.64%	
#200	26.9	2.43%	
-#200	2		
-200 wash	28.9		
Total	1271.9		

Gradation X, 11-01-95 — Lab # non-NCAT Ral–6

Sieve	Weight ret each sieve	Percent passing each sieve size	
1 1/2			
1		100.00%	correct gradation
1/2	13.8	98.96%	
3/8	256.7	79.61%	
#4	180	66.04%	
#8	306.8	42.76%	
#16	197.9	27.84%	
#30	133.9	17.75%	
#50	112.1	9.30%	
#100	66.43	6.04%	
#200	32.6	2.59%	
-#200	3		
-200 wash	31.3		
Total	1326.53		

Gradation X, 11-01-95 — Lab # non-NCAT Ral–7

Sieve	Weight ret each sieve	Percent passing each sieve size	
1 1/2			
1		100.00%	correct gradation
1/2	11.3	99.08%	
3/8	239.3	79.69%	
#4	168.2	66.05%	
#8	324.3	39.76%	
#16	184.9	24.77%	
#30	115.7	15.39%	
#50	90.2	8.08%	
#100	43	4.60%	
#200	24.2	2.63%	
-#200	1.3		
-200 wash	31.2		
Total	1233.6		

Gradation X, 11-01-95 — Lab # non-NCAT Ral–8

Sieve	Weight ret each sieve	Percent passing each sieve size	
1 1/2			
1		100.00%	correct gradation
1/2	16.2	98.69%	
3/8	210	81.77%	
#4	186.8	66.71%	
#8	291.9	43.18%	
#16	183.3	28.40%	
#30	127.1	18.15%	
#50	107.6	9.48%	
#100	52.8	5.22%	
#200	29.7	2.83%	
-#200	1.8		
-200 wash	33.3		
Total	1240.5		

TABLE B

1B

X

Gradation Analysis, 10-26-95 — Lab # NCAT Ral-1

Sieve	Weight ret each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2	30.1	97.60%
3/8	224.4	79.72%
#4	184.4	65.03%
#8	291.9	41.77%
#16	173.7	27.93%
#30	120	18.37%
#50	104.8	10.02%
#100	55.3	5.62%
#200	32.7	3.01%
-#200	2.6	
-200 wash	35.2	
Total	1255.1	

Gradation Analysis, 11-01-95 — Lab # NCAT Ral-2

Sieve	Weight ret each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2	15	98.76%
3/8	205	81.80%
#4	183.5	66.62%
#8	309.4	41.02%
#16	181.4	26.01%
#30	117.5	16.29%
#50	94.4	8.48%
#100	46.3	4.65%
#200	26.7	2.44%
-#200	2.1	
-200 wash	27.4	
Total	1206.7	

Gradation Analysis, 11-01-95 — Lab # NCAT Ral-3

Sieve	Weight ret each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2	24.2	98.11%
3/8	222.2	80.78%
#4	193.4	65.69%
#8	328	40.10%
#16	194.6	24.91%
#30	121.6	15.42%
#50	94	8.09%
#100	45.4	4.55%
#200	25.5	2.56%
-#200	1.9	
-200 wash	30.9	
Total	1281.7	

Gradation Analysis, 11-01-95 — Lab # NCAT Ral-4

Sieve	Weight ret each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2	21.4	98.23%
3/8	190.3	82.45%
#4	163.5	68.90%
#8	305.9	43.55%
#16	189.1	27.88%
#30	124.2	17.59%
#50	99.4	9.35%
#100	49.6	5.24%
#200	27.8	2.93%
-#200	1.7	
-200 wash	33.7	
Total	1206.6	

PAGOSA TROUT LAKES

GRADATION COMPARISON USING THE NCAT OVEN
TABLE A REPRESENTS THE GRADATION OF THE AGGREGATE WITH NO ASPHALT ADDED

TABLE B REPRESENTS THE GRADATION OF THE AGGREGATE AFTER ASPHALT WAS ADDED AND BURNT OFF INSIDE THE NCAT OVEN

TABLE A

1A

PURE AGGREGATE

Gradation X — Lab # 627x-1 — non-NCAT
10-10-85

Sieve	Weight ret. each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2	3	99.74%
3/8	305	73.50%
#4	314.3	46.45%
#8	153.3	33.26%
#16	122.2	22.75%
#30	77.4	16.08%
#50	58.1	11.09%
#100	40.8	7.57%
#200	26	5.33%
-#200	3.4	
-200 wash	58.6	
Total	1162.2	

correct gradation

TABLE B

1B

NCAT

X

Gradation Analysis — Lab # 627x-4
10-10-85

Sieve	Weight ret. each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2		100.00%
3/8	288.1	75.65%
#4	291.6	51.00%
#8	168.4	36.76%
#16	131.7	25.63%
#30	86.8	18.29%
#50	66.7	12.65%
#100	44.1	8.50%
#200	31.3	5.94%
-#200	2.3	
-200 wash	68	
Total	1183	

2A

Gradation Analysis — Lab # 627x-2 — non-NCAT
10-10-85

Sieve	Weight ret. each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2	2.6	99.80%
3/8	301.1	76.80%
#4	283.4	54.75%
#8	177.9	41.27%
#16	154	29.60%
#30	110.2	21.25%
#50	88.8	14.52%
#100	64.4	9.64%
#200	30.7	6.63%
-#200	2.5	
-200 wash	85	
Total	1318.6	

correct gradation

2B

Gradation Analysis — NCAT — Lab # 627x-5
10-10-85

Sieve	Weight retained in each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2		100.00%
3/8	284.6	76.34%
#4	287.9	52.40%
#8	198	35.85%
#16	126.3	25.35%
#30	85	18.28%
#50	69.2	12.53%
#100	50.1	8.36%
#200	30.5	5.83%
-#200	2.8	
-200 wash	67.2	
Total	1202.7	

3A

Gradation Analysis — Lab # 627x-3 — non-NCAT — X
10-10-85

Sieve	Weight ret. each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2	6.8	99.46%
3/8	348.8	72.27%
#4	312	47.95%
#8	204.4	32.01%
#16	125	22.27%
#30	83.5	15.76%
#50	66.2	10.59%
#100	46.5	6.97%
#200	28.6	4.74%
-#200	4	
-200 wash	56.8	
Total	1282.7	

correct gradation

3B

Gradation Analysis — Lab # 627x-6
10-10-85

Sieve	Weight retained in each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2		100.00%
3/8	302.9	74.83%
#4	288.5	50.48%
#8	153.7	37.58%
#16	125.6	27.07%
#30	87.9	19.71%
#50	70.4	13.81%
#100	62.2	8.44%
#200	33.8	6.61%
-#200	2.3	
-200 wash	76.6	
Total	1183.9	

NCAT

4A

Gradation Analysis — Lab # 627x-7 — non-NCAT
10-10-85

Sieve	Weight ret. each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2	2.6	99.79%
3/8	254	79.37%
#4	290.8	56.00%
#8	216.3	38.61%
#16	135.4	27.73%
#30	96.2	20.00%
#50	79.4	13.62%
#100	58.5	8.91%
#200	32	6.34%
-#200	1.2	
-200 wash	77.7	
Total:	1244.1	

correct gradation

5A

Gradation Analysis — Lab # 627x-8 — non-NCAT
10-10-85

Sieve	Weight ret. each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2		100.00%
3/8	310.2	75.03%
#4	309.5	50.12%
#8	197.7	34.20%
#16	122.2	24.37%
#30	85.4	17.49%
#50	69	11.94%
#100	49	7.99%
#200	29.2	5.64%
-#200	1.1	
-200 wash	69	
Total	1242.3	

correct gradation

Franciscotti 596x MIX

GRADATION COMPARISON USING THE NCAT OVEN
TABLE A REPRESENTS THE GRADATION OF THE AGGREGATE WITH NO ASPHALT ADDED

TABLE B REPRESENTS THE GRADATION OF THE AGGREGATE AFTER ASPHALT WAS ADDED AND BURNT OFF INSIDE THE NCAT OVEN

TABLE A

1A

10-24-95 AGGREGATE, LIME ADDED non-NCAT

Sieve	Weight retained in each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2	5.1	99.59%
3/8	396.4	67.61%
#4	312.1	42.44%
#8	145.7	30.68%
#16	102.3	22.43%
#30	87.2	15.40%
#50	69.6	9.78%
#100	44.9	6.16%
#200	29.5	3.78%
-#200	4	
-200 wash	42.9	
Total	1239.7	

2A

Gradation X 10-24-95 AGGREGATE, LIME ADDED non-NCAT Lab # 596x-6

Sieve	Weight retained in each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2		100.00%
3/8	373.6	70.25%
#4	323	44.52%
#8	133.8	33.86%
#16	94.2	26.36%
#30	91.9	19.04%
#50	82.8	12.45%
#100	57.4	7.88%
#200	38.6	4.80%
-#200	3.8	
-200 wash	56.5	
Total	1255.6	

3-A

Gradation X 10-24-95 non-NCAT AGGREGATE, LIME ADDED Lab # 596x-7

Sieve	Weight retained in each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2		100.00%
3/8	391.1	69.59%
#4	325.7	44.26%
#8	160.1	31.81%
#16	111.7	23.13%
#30	91.4	16.02%
#50	72.2	10.40%
#100	47	6.75%
#200	32.1	4.25%
-#200	4.1	
-200 wash	50.6	
Total	1286	

4-A

Gradation X 10-24-95 non-NCAT AGGREGATE, LIME ADDED Lab # 596x-8

Sieve	Weight retained in each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2	3.6	99.72%
3/8	371.8	71.11%
#4	307.5	47.45%
#8	150	35.91%
#16	116.6	26.94%
#30	106.1	18.78%
#50	88.1	12.00%
#100	57.4	7.58%
#200	37.5	4.69%
-#200	3.6	
-200 wash	57.4	
Total	1299.6	

TABLE B

1B
NCAT
10-23-95

Sieve	Weight retained in each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2	6.1	99.49%
3/8	336.1	71.45%
#4	300.6	46.37%
#8	161.6	32.88%
#16	104.5	24.16%
#30	83.1	17.23%
#50	70.8	11.32%
#100	48.6	7.27%
#200	32.8	4.53%
-#200	2.7	
-200 wash	51.6	
Total	1198.5	

Gradation Analysis Lab # 596x-2
10-23-95 2B

Sieve	Weight retained in each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2	7.2	99.41%
3/8	365.6	69.52%
#4	299.7	45.01%
#8	138.9	33.65%
#16	107.7	24.84%
#30	91.8	17.34%
#50	73.8	11.30%
#100	48.3	7.35%
#200	32	4.73%
-#200	2.3	
-200 wash	55.6	
Total	1222.9	

Gradation Analysis Lab # 596x-3
10-23-95

Sieve	Weight retained in each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2	3.4	99.73%
3/8	363.6	70.47%
#4	302.3	46.14%
#8	154.3	33.72%
#16	115	24.46%
#30	95.6	16.77%
#50	74	10.82%
#100	47.7	6.98%
#200	32.3	4.38%
-#200	4.6	
-200 wash	49.8	
Total	1242.6	

Gradation Analysis Lab # 596x-4
10-23-95

Sieve	Weight retained in each sieve	Percent passing each sieve size
1 1/2		
1		100.00%
1/2		100.00%
3/8	370.1	70.66%
#4	313.1	45.83%
#8	147.1	34.17%
#16	107	25.69%
#30	95.6	18.11%
#50	79.2	11.83%
#100	53.5	7.59%
#200	35.6	4.76%
-#200	3.8	
-200 wash	56.3	
Total	1261.3	

IRWIN/WINSOR/STUTE P 647x MIX

GRADATION COMPARISON USING THE NCAT OVEN
TABLE A REPRESENTS THE GRADATION OF THE AGGREGATE WITH NO ASPHALT ADDED

TABLE B REPRESENTS THE GRADATION OF THE AGGREGATE AFTER ASPHALT WAS ADDED AND BURNT OFF INSIDE THE N

TABLE
A

NON-NCAT

-5

1/2		100.00%
3/8	246.5	80.67%
#4	263.9	59.97%
#8	216.2	43.01%
#16	145.4	31.60%
#30	120.6	22.14%
#50	105.3	13.88%
#100	71.3	8.29%
#200	42.1	4.99%
-#200	10.8	
-200 wash	52.8	
Total:	1274.9	

-6

1/2	4	99.70%
3/8	243.2	81.64%
#4	287.8	60.27%
#8	217.1	44.14%
#16	166.1	31.81%
#30	131.7	22.03%
#50	109.4	13.90%
#100	71.8	8.57%
#200	41.5	5.49%
-#200	6.1	
-200 wash	67.8	
Total:	1346.5	

-7

?

1/2		100.00%
3/8	276.7	75.87%
#4	220.5	56.65%
#8	166.1	42.17%
#16	137.3	30.19%
#30	114.9	20.18%
#50	90	12.33%
#100	55.8	7.46%
#200	32	4.67%
-#200	7.5	
-200 wash	46.1	
Total:	1146.9	

-8

1/2	7.6	99.40%
3/8	242.5	80.37%
#4	248.6	60.86%
#8	204.3	44.82%
#16	146.6	33.32%
#30	125	23.51%
#50	112.1	14.71%
#100	75	8.82%
#200	44.3	5.34%
-#200	10.2	
-200 wash	57.9	
Total:	1274.1	

NCAT

-1

1/2	2.9	99.78%
3/8	258.7	79.98%
#4	278.8	58.65%
#8	184.9	44.50%
#16	140.3	33.76%
#30	122.1	24.42%
#50	112.8	15.79%
#100	79.1	9.73%
#200	47.5	6.10%
-#200	6.4	
-200 wash	73.3	
Total:	1306.8	

-2

1/2	6.4	99.45%
3/8	199.7	82.21%
#4	255.9	60.11%
#8	202.3	42.64%
#16	145.8	30.06%
#30	107.2	20.80%
#50	86.1	13.37%
#100	56.7	8.47%
#200	33.3	5.59%
-#200	4.1	
-200 wash	60.7	
Total:	1158.2	

-3

1/2		100.00%
3/8	273.2	78.89%
#4	263.9	58.50%
#8	202.3	42.87%
#16	153.6	31.01%
#30	119.6	21.76%
#50	100.3	14.02%
#100	68	8.76%
#200	41.1	5.59%
-#200	5.6	
-200 wash	66.7	
Total	1294.3	

-4

1/2		100.00%
3/8	253.7	79.60%
#4	234.2	60.78%
#8	188.4	45.63%
#16	150.5	33.53%
#30	122.2	23.71%
#50	104.1	15.34%
#100	70.6	9.66%
#200	42.5	6.25%
-#200	4.7	
-200 wash	73	
Total:	1243.9	

VALCO/ROCKY MOUNTAIN 688x Mix

GRADATION COMPARISON USING THE NCAT OVEN
TABLE A REPRESENTS THE GRADATION OF THE AGGREGATE WITH NO ASPHALT ADDED

TABLE B REPRESENTS THE GRADATION OF THE AGGREGATE AFTER ASPHALT WAS ADDED AND BURNT OFF INSIDE THE NCAT OVEN

TABLE A — NON-NCAT

-5

1/2		100.00%
3/8	297.5	75.67%
#4	171.1	61.68%
#8	200.1	45.32%
#16	119.6	35.54%
#30	110.7	26.49%
#50	176.6	12.05%
#100	86.2	5.00%
#200	27.1	2.78%
-#200	2.7	
-200 wash	31.3	
Total:	1222.9	

-6

1/2	5.9	99.51%
3/8	311	73.90%
#4	179.7	59.11%
#8	192	43.30%
#16	122.6	33.20%
#30	109.2	24.21%
#50	162.3	10.84%
#100	77.2	4.49%
#200	23.6	2.54%
-#200	2.4	
-200 wash	28.5	
Total:	1214.4	

-7

1/2	3	99.76%
3/8	307.5	75.41%
#4	174.9	61.56%
#8	198.3	45.86%
#16	114.5	36.79%
#30	115.1	27.68%
#50	190.6	12.58%
#100	92.1	5.29%
#200	28.5	3.03%
-#200	1.9	
-200 wash	36.4	
Total:	1262.8	

-8

1/2		100.00%
3/8	358.3	72.81%
#4	167.1	60.13%
#8	207.7	44.37%
#16	123.5	35.00%
#30	122.4	25.71%
#50	188.2	11.43%
#100	89.8	4.61%
#200	27	2.56%
-#200	3.1	
-200 wash	30.7	
Total:	1317.8	

TABLE B — NCAT / TABLE B — NCAT

-1

	NCAT		NCAT	
1/2		100.00%		100.00%
3/8	349.5	71.69%	349.5	71.69%
#4	144.4	60.00%	144.4	60.00%
#8	204.5	43.43%	204.5	43.43%
#16	126.9	33.15%	126.9	33.15%
#30	110.2	24.23%	110.2	24.23%
#50	159.7	11.29%	159.7	11.29%
#100	79.4	4.86%	79.4	4.86%
#200	26.1	2.75%	26.1	2.75%
-#200	3.1		3.1	
-200 wash	30.8		30.8	
Total:	1234.6		1234.6	

-2

	NCAT		NCAT	
1/2	4.8	99.62%	4.8	99.62%
3/8	340.5	72.94%	340.5	72.94%
#4	157.9	60.56%	157.9	60.56%
#8	187.7	45.85%	187.7	45.85%
#16	120.6	36.40%	120.6	36.40%
#30	117.5	27.19%	117.5	27.19%
#50	185.9	12.62%	185.9	12.62%
#100	93.9	5.26%	93.9	5.26%
#200	30.7	2.85%	30.7	2.85%
-#200	3.9		3.9	
-200 wash	32.5		32.5	
Total:	1275.9		1275.9	

-3

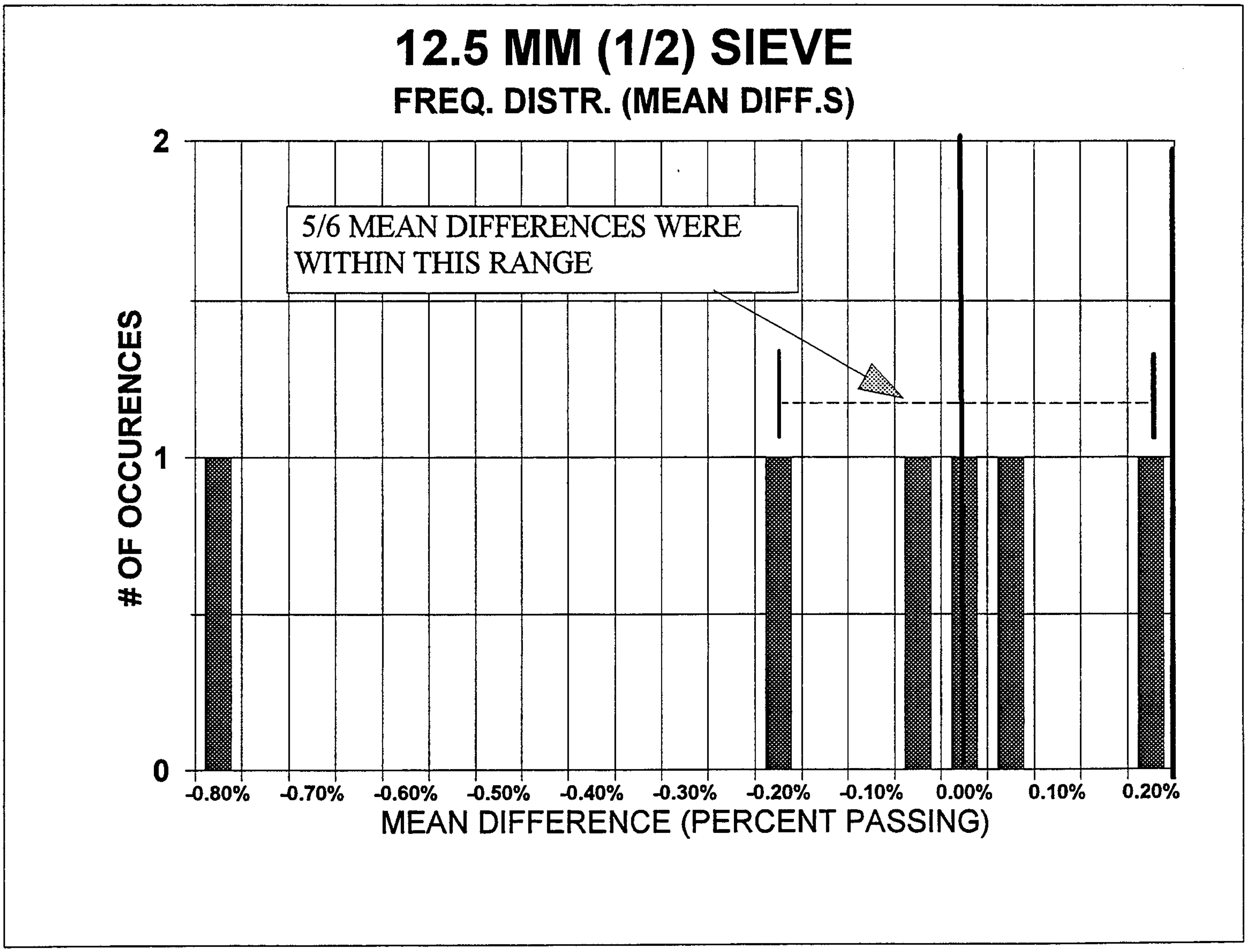
	NCAT		NCAT	
1/2	5.3	99.55%	5.3	99.55%
3/8	285.5	75.29%	285.5	75.29%
#4	175.9	60.34%	175.9	60.34%
#8	184.9	44.62%	184.9	44.62%
#16	120.8	34.36%	120.8	34.36%
#30	109.8	25.03%	109.8	25.03%
#50	160.5	11.39%	160.5	11.39%
#100	77.4	4.81%	77.4	4.81%
#200	24.2	2.75%	24.2	2.75%
-#200	2.2		2.2	
-200 wash	30.2		30.2	
Total:	1176.7		1176.7	

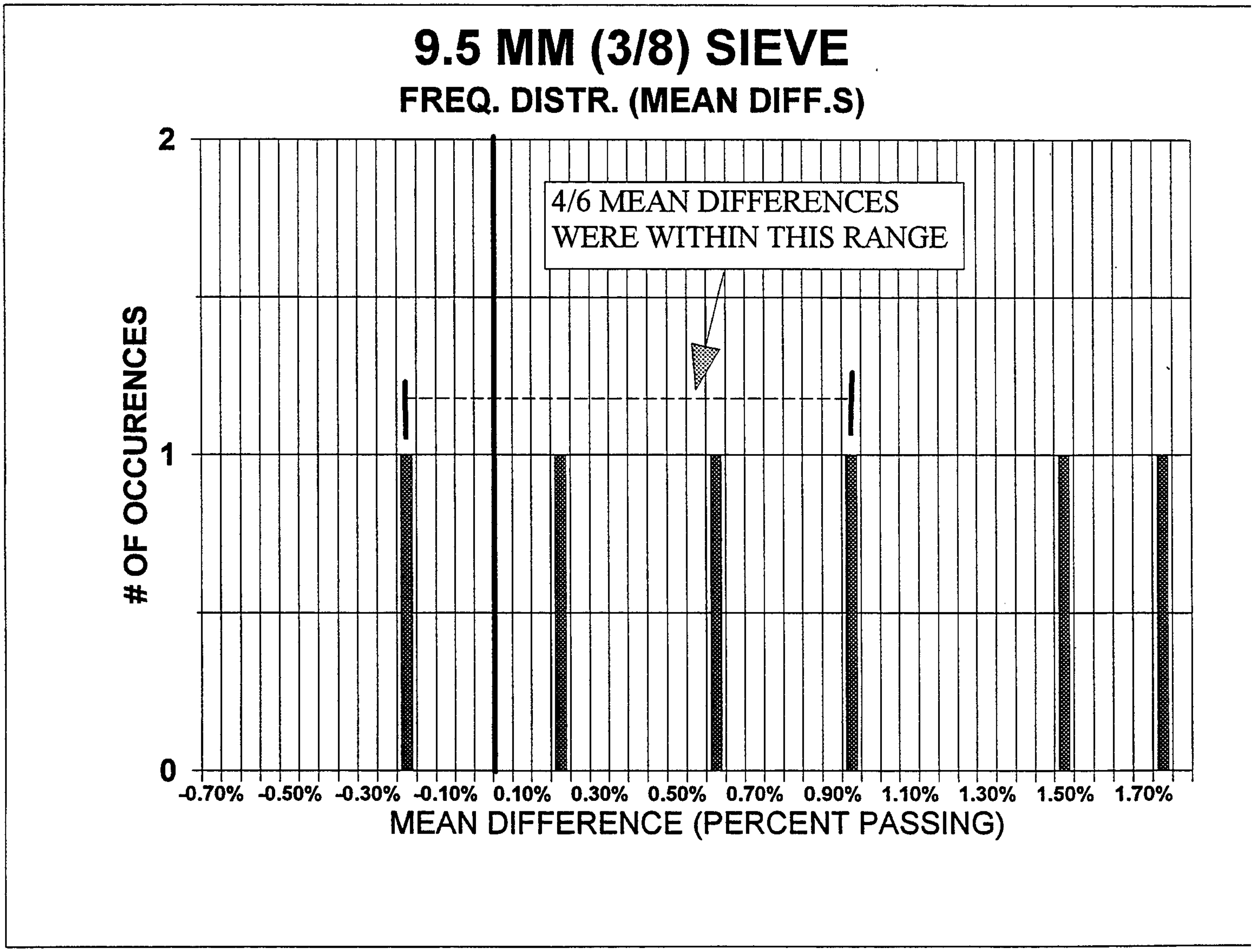
-4

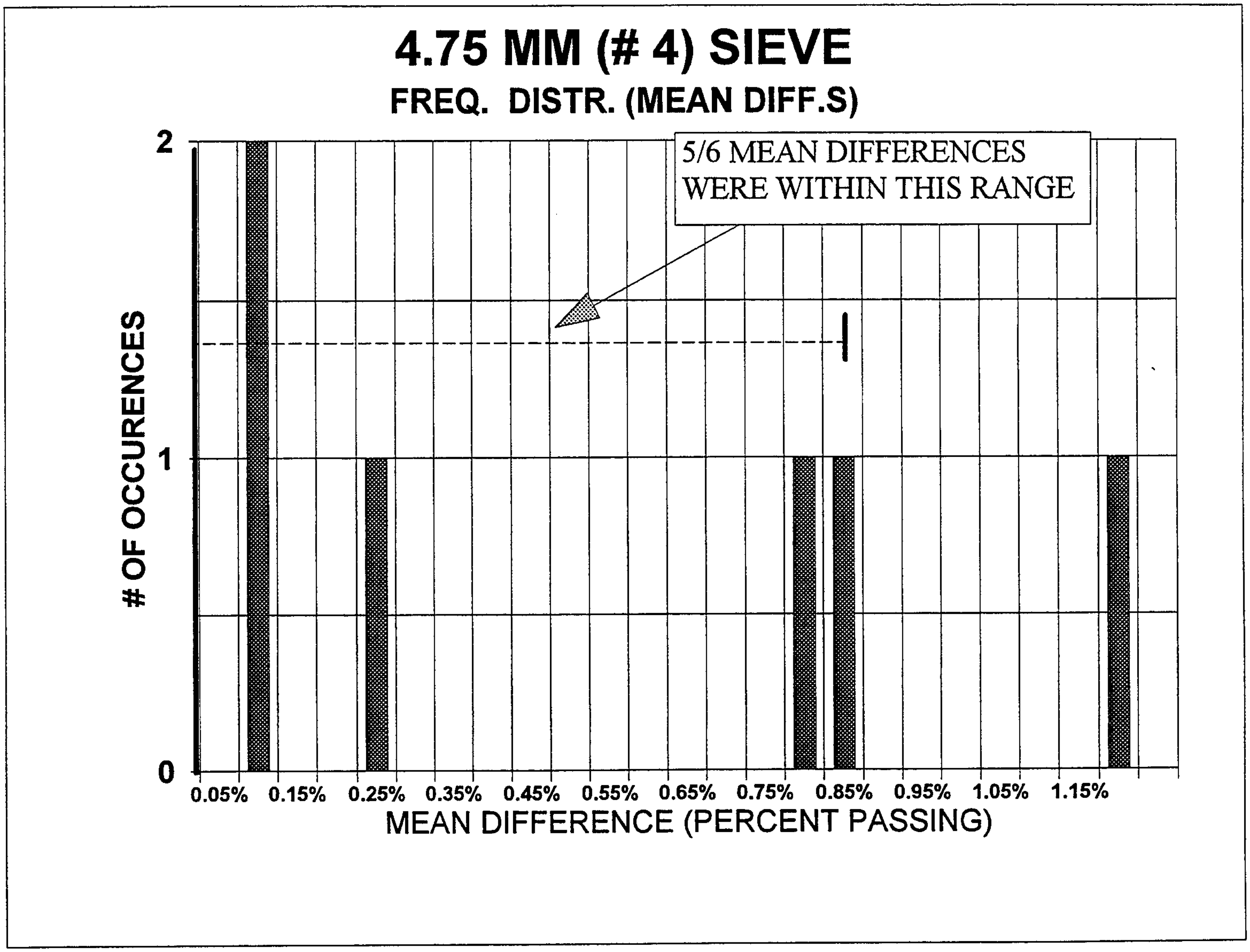
	NCAT		NCAT	
1/2		100.00%		100.00%
3/8	303.9	76.69%	303.9	76.69%
#4	155.4	64.77%	155.4	64.77%
#8	216.9	48.14%	216.9	48.14%
#16	147.4	36.83%	147.4	36.83%
#30	130.8	26.80%	130.8	26.80%
#50	191.3	12.13%	191.3	12.13%
#100	91.6	5.10%	91.6	5.10%
#200	30	2.80%	30	2.80%
-#200	3.9		3.9	
-200 wash	32.6		32.6	
Total:	1303.8		1303.8	

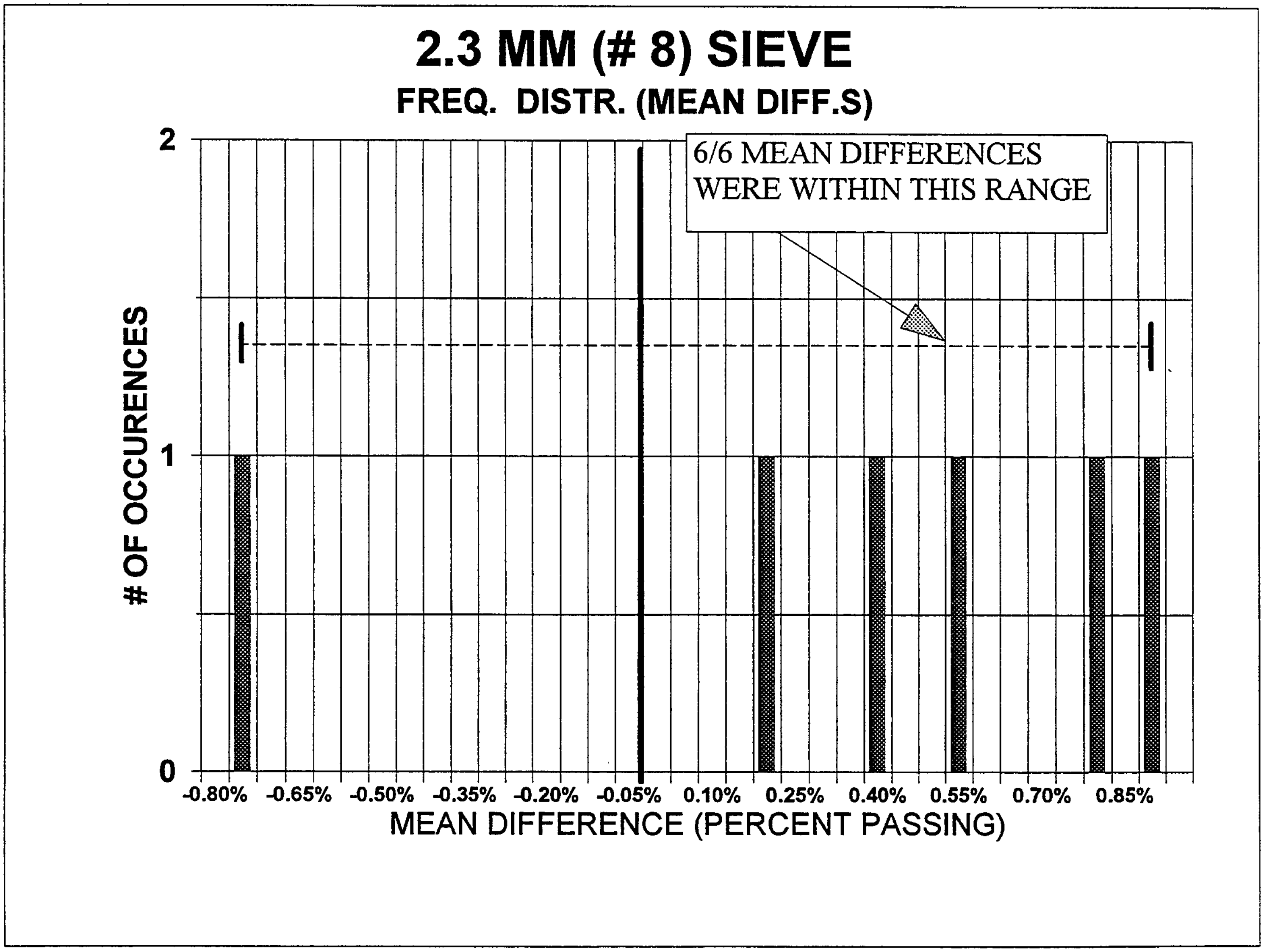
APPENDIX C

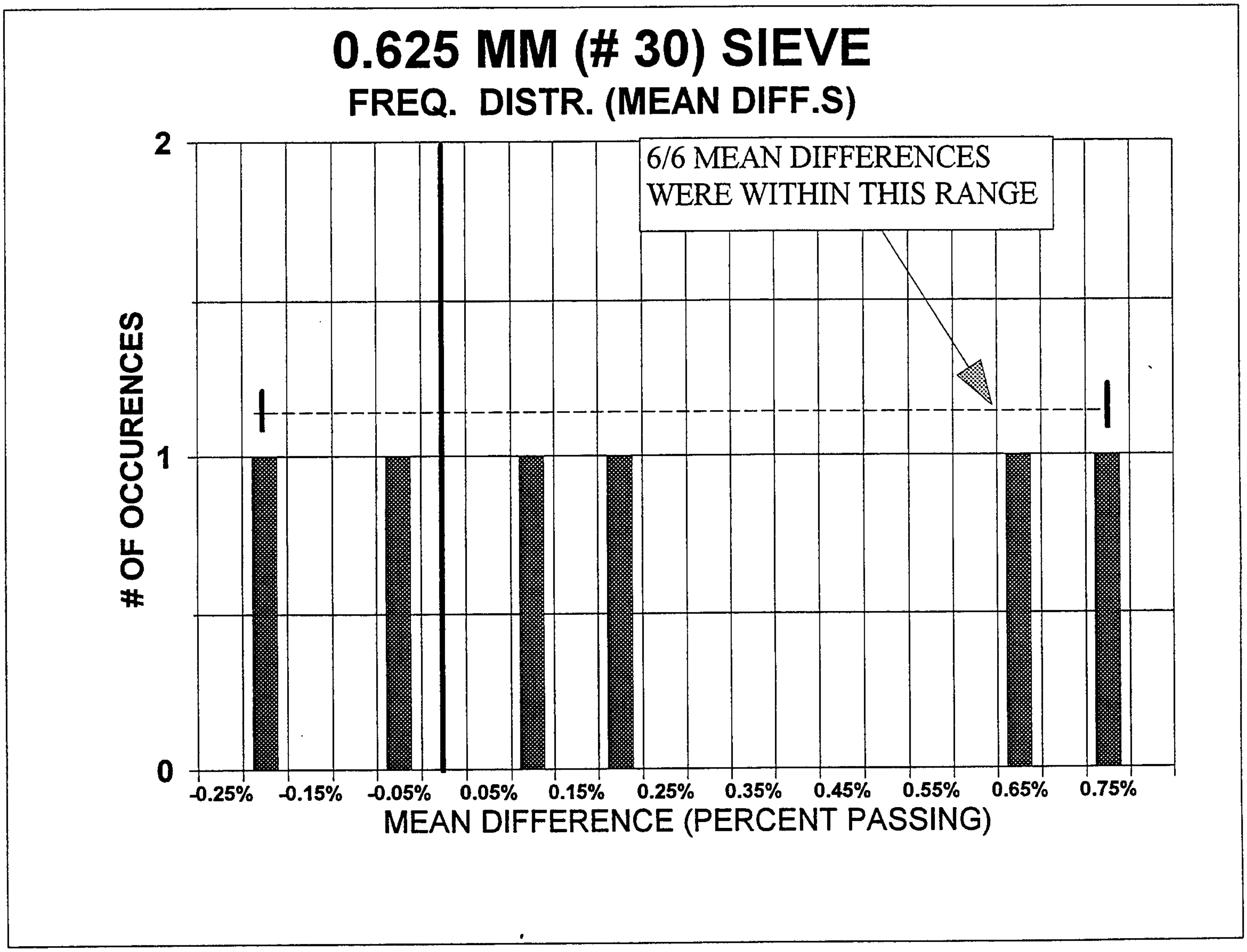
*** Frequency Figures for Each Sieve Size**

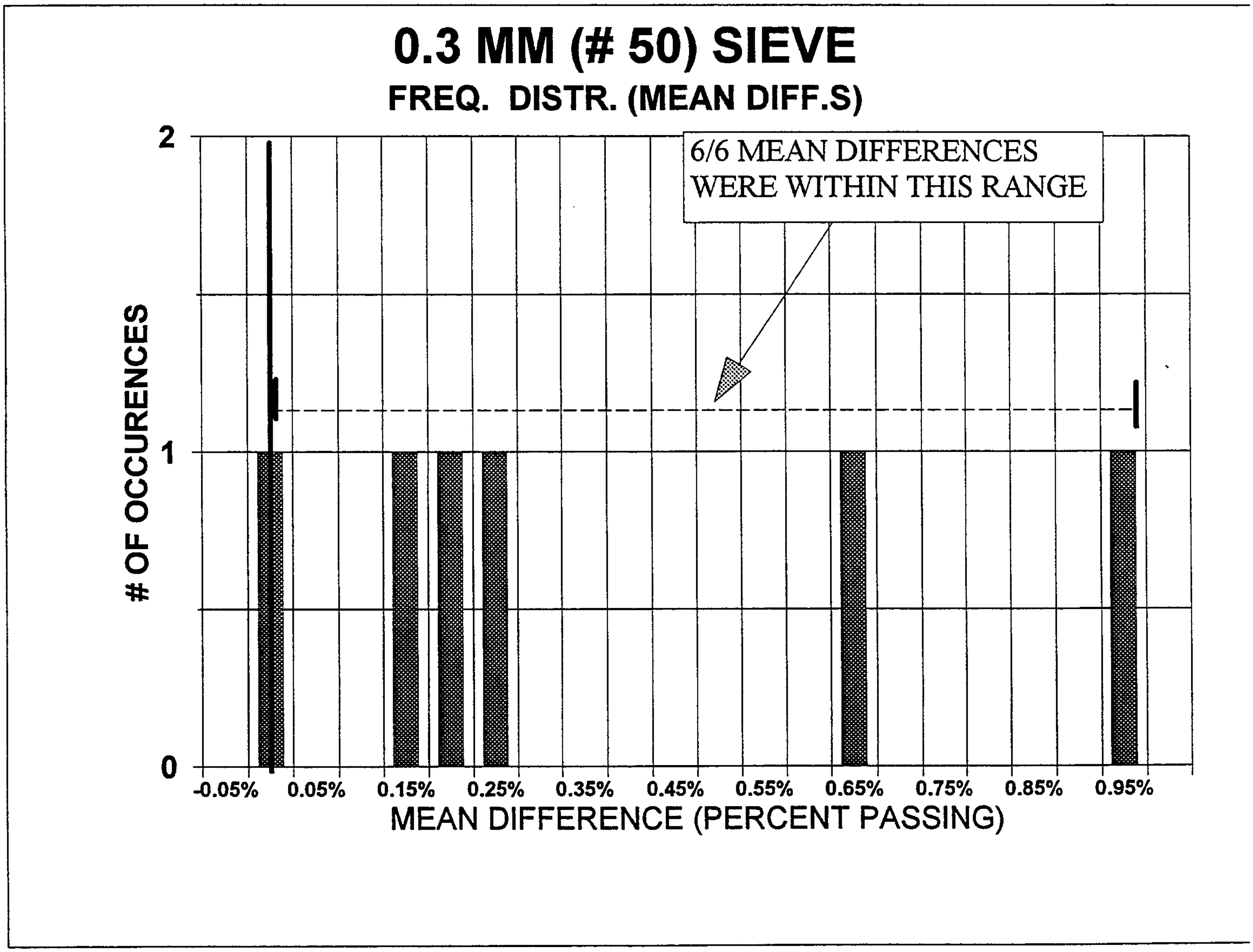

12.5 MM (1/2) SIEVE
FREQ. DISTR. (MEAN DIFF.S)
5/6 MEAN DIFFERENCES WERE WITHIN THIS RANGE
OF OCCURENCES
2
1
0
-0.80%
-0.70%
-0.60%
-0.50%
-0.40%
-0.30%
-0.20%
-0.10%
0.00%
0.10%
0.20%
MEAN DIFFERENCE (PERCENT PASSING)

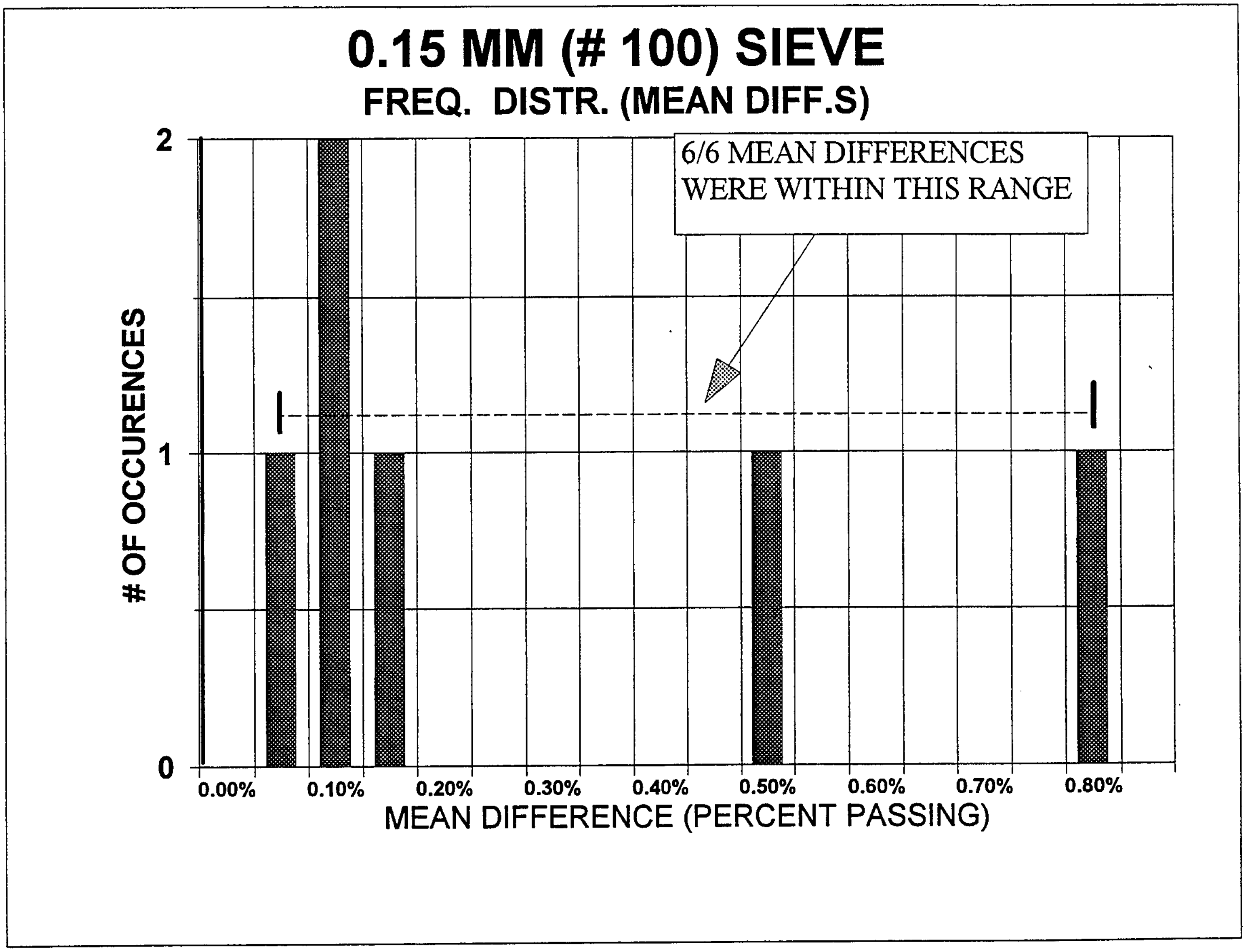

9.5 MM (3/8) SIEVE
FREQ. DISTR. (MEAN DIFF.S)
4/6 MEAN DIFFERENCES WERE WITHIN THIS RANGE
OF OCCURENCES
2
1
0
-0.70% -0.50% -0.30% -0.10% 0.10% 0.30% 0.50% 0.70% 0.90% 1.10% 1.30% 1.50% 1.70%
MEAN DIFFERENCE (PERCENT PASSING)

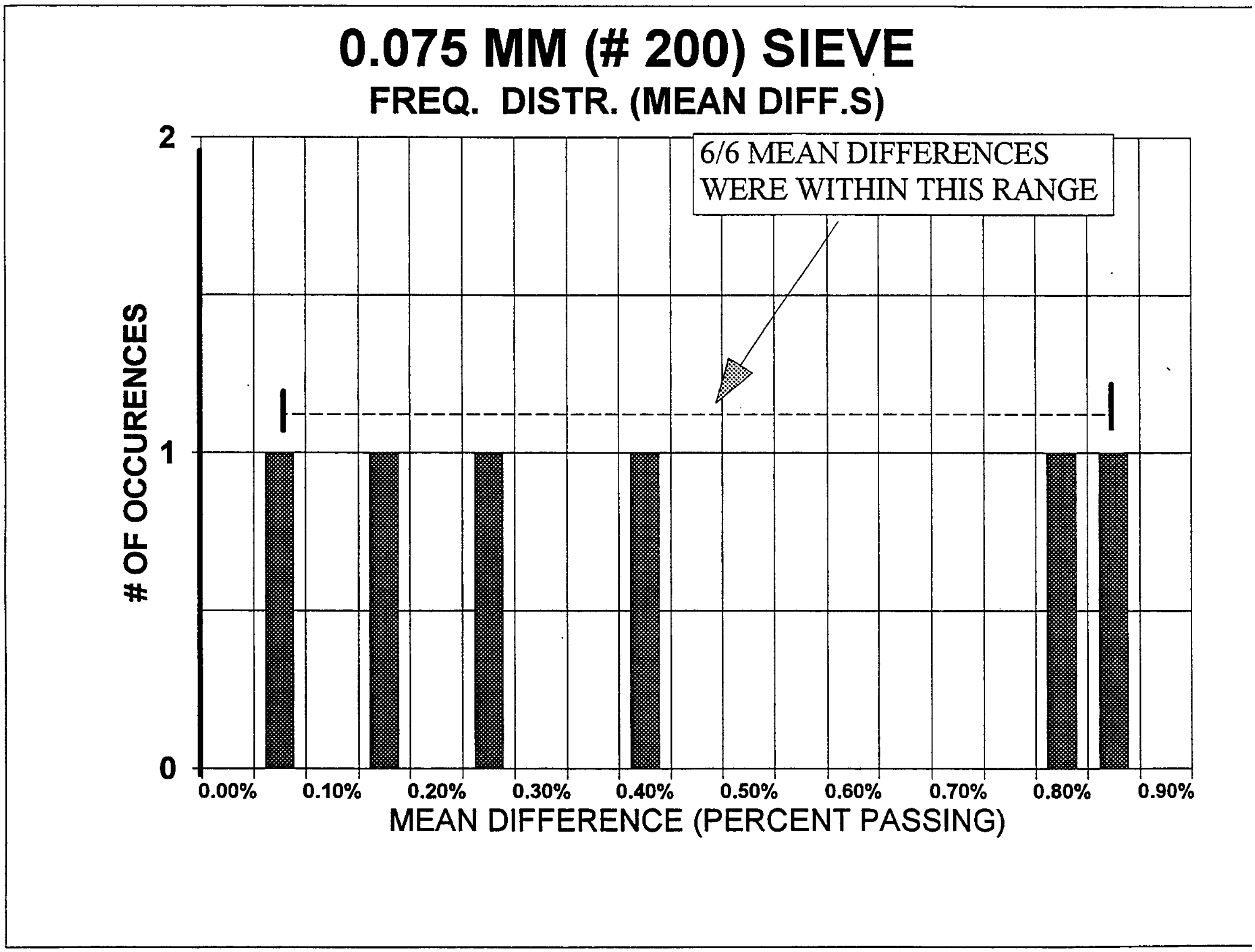

4.75 MM (# 4) SIEVE
FREQ. DISTR. (MEAN DIFF.S)
5/6 MEAN DIFFERENCES
WERE WITHIN THIS RANGE
OF OCCURENCES
2
1
0
0.05%
0.15%
0.25%
0.35%
0.45%
0.55%
0.65%
0.75%
0.85%
0.95%
1.05%
1.15%
MEAN DIFFERENCE (PERCENT PASSING)


2.3 MM (# 8) SIEVE
FREQ. DISTR. (MEAN DIFF.S)
6/6 MEAN DIFFERENCES WERE WITHIN THIS RANGE
OF OCCURENCES
2
1
0
-0.80%
-0.65%
-0.50%
-0.35%
-0.20%
-0.05%
0.10%
0.25%
0.40%
0.55%
0.70%
0.85%
MEAN DIFFERENCE (PERCENT PASSING)


0.625 MM (# 30) SIEVE
FREQ. DISTR. (MEAN DIFF.S)
6/6 MEAN DIFFERENCES WERE WITHIN THIS RANGE
OF OCCURENCES
2
1
0
-0.25%
-0.15%
-0.05%
0.05%
0.15%
0.25%
0.35%
0.45%
0.55%
0.65%
0.75%
MEAN DIFFERENCE (PERCENT PASSING)


0.3 MM (# 50) SIEVE
FREQ. DISTR. (MEAN DIFF.S)
6/6 MEAN DIFFERENCES WERE WITHIN THIS RANGE
OF OCCURENCES
2
1
0
-0.05%
0.05%
0.15%
0.25%
0.35%
0.45%
0.55%
0.65%
0.75%
0.85%
0.95%
MEAN DIFFERENCE (PERCENT PASSING)


0.15 MM (# 100) SIEVE
FREQ. DISTR. (MEAN DIFF.S)
6/6 MEAN DIFFERENCES
WERE WITHIN THIS RANGE
OF OCCURENCES
2
1
0
0.00%
0.10%
0.20%
0.30%
0.40%
0.50%
0.60%
0.70%
0.80%
MEAN DIFFERENCE (PERCENT PASSING)


0.075 MM (# 200) SIEVE
FREQ. DISTR. (MEAN DIFF.S)
6/6 MEAN DIFFERENCES
WERE WITHIN THIS RANGE
OF OCCURENCES
2
1
0
0.00%
0.10%
0.20%
0.30%
0.40%
0.50%
0.60%
0.70%
0.80%
0.90%
MEAN DIFFERENCE (PERCENT PASSING)

APPENDIX D

METHOD TWO

* Data Used to Create Figure 6
* Data Used to Create Figure 7
* Data Used to Create Figure 8
* Determination of Correction Factors Using Analysis Method Two

DATA USED TO GENERATE FIGURE 6

FRANCISCOTTI

FRANCISCOTTI

EXPERIMENTAL

SIEVE SIZE	AGGREGATE DESCRIPTION	PERCENT PASSING EACH SIEVE SIZE	PERCENT PASSING ONE SIEVI AND RETAINED ON THE NEXT FINER SIEVE	SINGLE OPERATOR PRECISION A: AFTER 3 SPLITS STANDARD DEVIATION OF THE PERCENT DIFF.S BETWEEN EXP. AND CONTROL SPECIMENS ALL POSSIBLE COMBINATIONS PRECISON (1S),%	B: AASHTO T 27 AFTER 1 SPLIT AGGREGATE ONLY 100 PAIRED TEST RESULTS PRECISION (1S),%	DIFF. BETWEEN COLUMN A - COLUMN B PRECISION (1S),%
1/2	COARSE	99.66%		0.30		
3/8	COARSE	70.52%	29.14%	1.51	1.38	0.13
#4	FINE	45.84%	24.69%	1.93	0.64	1.29
#8	FINE	33.61%	12.23%	2.12	0.60	1.52
#16	FINE	24.79%	8.82%	2.11	0.43	1.68
#30	FINE	17.36%	7.43%	1.20	0.43	0.77
#50	FINE	11.32%	6.04%	1.19	0.43	0.76
#100	FINE	7.30%	4.02%	0.73	0.43	0.30
#200	FINE	4.60%	2.69%	0.45	0.14	0.31

WINDSOR/IRWIN

WINDSOR/IRWIN

EXPERIMENTAL

SIEVE SIZE	AGGREGATE DESCRIPTION	PERCENT PASSING EACH SIEVE SIZE	PERCENT PASSING ONE SIEVI AND RETAINED ON THE NEXT FINER SIEVE	SINGLE OPERATOR PRECISION A: AFTER 3 SPLITS STANDARD DEVIATION OF THE PERCENT DIFF.S BETWEEN EXP. AND CONTROL SPECIMENS ALL POSSIBLE COMBINATIONS PRECISON (1S),%	B: AASHTO T 27 AFTER 1 SPLIT AGGREGATE ONLY 100 PAIRED TEST RESULTS PRECISION (1S),%	DIFF. BETWEEN COLUMN A - COLUMN B PRECISION (1S),%
SIEVE SIZE						
1/2	COARSE	99.81%		0.35		
3/8	COARSE	80.17%	19.64%	2.63	0.95	1.68
#4	FINE	59.51%	20.66%	1.97	0.64	1.33
#8	FINE	43.91%	15.60%	1.70	0.60	1.1
#16	FINE	32.09%	11.82%	2.01	0.60	1.41
#30	FINE	22.67%	9.42%	1.94	0.43	1.51
#50	FINE	14.63%	8.05%	1.35	0.43	0.92
#100	FINE	9.16%	5.47%	0.78	0.43	0.35
#200	FINE	5.88%	3.28%	0.45	0.43	0.02

RALSTON

RALSTON

EXPERIMENTAL

SIEVE SIZE	AGGREGATE DESCRIPTION	PERCENT PASSING EACH SIEVE SIZE	PERCENT PASSING ONE SIEVI AND RETAINED ON THE NEXT FINER SIEVE	SINGLE OPERATOR PRECISION A: AFTER 3 SPLITS STANDARD DEVIATION OF THE PERCENT DIFF.S BETWEEN EXP. AND CONTROL SPECIMENS ALL POSSIBLE COMBINATIONS PRECISON (1S),% COMBINATIONS PRECISON (D1S),%	B: AASHTO T 27 AFTER 1 SPLIT AGGREGATE ONLY 100 PAIRED TEST RESULTS PRECISION (1S),% COMBINATIONS PRECISION (D2S),%	DIFF. BETWEEN COLUMN A - COLUMN B PRECISION (1S),%
SIEVE SIZE						
1/2	COARSE	98.17%		0.57		
3/8	COARSE	81.19%	16.99%	1.77	0.95	0.82
#4	FINE	66.56%	14.63%	1.8	0.6	1.2
#8	FINE	41.61%	24.95%	2.3	0.64	1.66
#16	FINE	26.68%	14.93%	2.12	0.6	1.52
#30	FINE	16.92%	9.77%	1.72	0.43	1.29
#50	FINE	8.99%	7.93%	1.01	0.43	0.58
#100	FINE	5.01%	3.97%	0.54	0.43	0.11
#200	FINE	2.74%	2.28%	0.29	0.14	0.15

DATA USED TO GENERATE FIGURE 6

MONK — EXPERIMENTAL

SIEVE SIZE	AGGREGATE DESCRIPTION	PERCENT PASSING EACH SIEVE SIZE	PERCENT PASSING ONE SIEVE AND RETAINED ON THE NEXT FINER SIEVE	SINGLE OPERATOR PRECISION A: AFTER 3 SPLITS STANDARD DEVIATION OF THE PERCENT DIFF.S BETWEEN EXP. AND CONTROL SPECIMENS ALL POSSIBLE COMBINATIONS PRECISON (1S),% COMBINATIONS PRECISON (D1S),%	SINGLE OPERATOR PRECISION B: AASHTO T 27 AFTER 1 SPLIT AGGREGATE ONLY 100 PAIRED TEST RESULTS PRECISION (1S),%	MONK DIFF. BETWEEN COLUMN A - COLUMN B PRECISION (1S),%
1/2	COARSE	99.29%		0.59		
3/8	COARSE	81.99%	17.30%	1.91	0.95	0.96
#4	FINE	64.10%	17.89%	1.73	0.60	1.13
#8	FINE	41.67%	22.43%	2.33	0.64	1.69
#16	FINE	29.43%	12.24%	2.97	0.60	2.37
#30	FINE	21.19%	8.24%	2.72	0.43	2.29
#50	FINE	13.53%	7.65%	1.78	0.43	1.35
#100	FINE	7.85%	5.69%	1.2	0.43	0.77
#200	FINE	4.34%	3.50%	2.13	0.43	1.7

VALCO — EXPERIMENTAL

SIEVE SIZE	AGGREGATE DESCRIPTION	PERCENT PASSING EACH SIEVE SIZE	PERCENT PASSING ONE SIEVE AND RETAINED ON THE NEXT FINER SIEVE	SINGLE OPERATOR PRECISION A: AFTER 3 SPLITS STANDARD DEVIATION OF THE PERCENT DIFF.S BETWEEN EXP. AND CONTROL SPECIMENS ALL POSSIBLE COMBINATIONS PRECISON (1S),% COMBINATIONS PRECISON (D1S),%	SINGLE OPERATOR PRECISION B: AASHTO T 27 AFTER 1 SPLIT AGGREGATE ONLY 100 PAIRED TEST RESULTS PRECISION (1S),%	VALCO DIFF. BETWEEN COLUMN A - COLUMN B PRECISION (1S),%
1/2	COARSE	99.79%		0.30		
3/8	COARSE	74.15%	25.64%	2.35	1.38	0.97
#4	FINE	61.42%	12.73%	2.29	0.60	1.69
#8	FINE	45.51%	15.91%	2.06	0.60	1.46
#16	FINE	35.18%	10.33%	2.04	0.60	1.44
#30	FINE	25.81%	9.37%	1.81	0.43	1.38
#50	FINE	11.86%	13.95%	0.88	0.60	0.28
#100	FINE	5.01%	6.85%	0.38	0.43	-0.05
#200	FINE	2.77%	2.24%	0.21	0.14	0.07

PAGOSA — EXPERIMENTAL

SIEVE SIZE	AGGREGATE DESCRIPTION	PERCENT PASSING EACH SIEVE SIZE	PERCENT PASSING ONE SIEVE AND RETAINED ON THE NEXT FINER SIEVE	SINGLE OPERATOR PRECISION A: AFTER 3 SPLITS STANDARD DEVIATION OF THE PERCENT DIFF.S BETWEEN EXP. AND CONTROL SPECIMENS ALL POSSIBLE COMBINATIONS PRECISON (1S),% COMBINATIONS PRECISON (D1S),%	SINGLE OPERATOR PRECISION B: AASHTO T 27 AFTER 1 SPLIT AGGREGATE ONLY 100 PAIRED TEST RESULTS PRECISION (1S),%	PAGOSA DIFF. BETWEEN COLUMN A - COLUMN B PRECISION (1S),%
1/2	COARSE	100.00%		0.35		
3/8	COARSE	75.54%	24.46%	2.63	1.38	1.25
#4	FINE	51.29%	24.25%	1.97	0.64	1.33
#8	FINE	36.74%	14.55%	1.7	0.60	1.1
#16	FINE	26.02%	10.72%	2.01	0.60	1.41
#30	FINE	18.76%	7.26%	1.94	0.43	1.51
#50	FINE	13.00%	5.76%	1.35	0.43	0.92
#100	FINE	8.80%	4.20%	0.78	0.46	0.32
#200	FINE	6.13%	2.67%	0.45	0.14	0.31

DIFFERENCES BETWEEN EXP. AND CONTROL SPECIMENS

FRANCISCOTTI (16 COMBINATIONS)

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
	-0.10%	3.83%	3.93%	2.20%	1.73%	1.83%	1.54%	1.10%	0.75%
	-0.51%	1.20%	1.85%	-0.98%	-2.20%	1.83%	-1.13%	-0.61%	-0.27%
	-0.51%	1.86%	2.11%	1.07%	1.04%	1.21%	0.92%	0.52%	0.28%
	-0.23%	0.33%	-1.09%	-3.03%	-2.78%	0.62%	-0.67%	-0.31%	-0.16%
	-0.59%	-0.73%	0.49%	-0.21%	-1.52%	-1.71%	-1.15%	-0.53%	-0.07%
	-0.59%	-0.07%	0.75%	1.84%	1.72%	-1.71%	0.90%	0.60%	0.48%
	-0.31%	-1.60%	-2.45%	-2.26%	-2.10%	-1.44%	-0.69%	-0.23%	0.04%
	-0.18%	1.90%	2.57%	2.96%	2.41%	-0.27%	1.52%	1.19%	0.95%
	-0.27%	0.88%	1.88%	1.91%	1.34%	0.75%	0.41%	0.23%	0.12%
	0.00%	-0.65%	-1.32%	-2.19%	-2.47%	0.75%	-1.18%	-0.60%	-0.32%
	0.14%	2.85%	3.70%	3.03%	2.03%	1.37%	1.03%	0.81%	0.59%
	-0.27%	0.22%	1.62%	-0.14%	-1.90%	-0.62%	-1.63%	-0.90%	-0.42%
	0.28%	-0.46%	-1.62%	-1.74%	-1.25%	-0.67%	-0.17%	0.01%	0.07%
	0.41%	3.04%	3.40%	3.49%	3.25%	-0.67%	2.04%	1.42%	0.98%
	0.00%	0.41%	1.31%	0.31%	-0.67%	-0.93%	-0.62%	-0.29%	-0.04%
16 COMBINATIONS	0.00%	1.07%	1.57%	2.36%	2.56%	0.27%	1.42%	0.84%	0.51%
FRANCISCOTTI									
MEAN	**-0.17%**	**0.88%**	**1.17%**	**0.54%**	**0.07%**	**0.04%**	**0.16%**	**0.20%**	**0.22%**
STD. DEV.	**0.30%**	**1.51%**	**1.93%**	**2.12%**	**2.11%**	**1.20%**	**1.19%**	**0.73%**	**0.45%**

RALSTON (16 COMBINATIONS)

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
	-1.48%	1.79%	0.84%	1.80%	2.80%	2.70%	1.81%	1.07%	0.58%
	-1.36%	0.11%	-1.01%	-0.99%	0.09%	0.63%	0.73%	0.57%	0.43%
	-1.48%	0.04%	-1.02%	2.01%	3.16%	2.98%	1.94%	1.02%	0.38%
	0.12%	-2.04%	-1.68%	-3.00%	-0.47%	0.22%	0.54%	0.39%	0.18%
	-0.20%	2.19%	0.58%	-1.74%	-1.83%	-1.46%	-0.82%	-0.39%	-0.15%
	-0.32%	2.11%	0.57%	1.26%	1.24%	0.90%	0.40%	0.05%	-0.19%
	0.06%	0.03%	-0.09%	-2.16%	-2.39%	-1.86%	-1.00%	-0.57%	-0.39%
	-0.39%	3.87%	2.43%	3.41%	0.88%	0.61%	0.26%	0.11%	0.01%
	-0.97%	1.09%	-0.36%	0.33%	0.14%	0.03%	0.01%	-0.05%	-0.08%
	-0.58%	-0.99%	-1.02%	-3.08%	-3.49%	-2.73%	-1.39%	-0.68%	-0.27%
	-0.97%	2.84%	1.50%	0.12%	-0.22%	-0.25%	-0.13%	0.00%	0.13%
	0.39%	1.17%	-0.35%	-3.20%	-2.93%	-2.32%	-1.21%	-0.49%	-0.03%
	-0.47%	0.69%	2.20%	0.38%	-0.52%	-0.57%	-0.13%	0.01%	0.10%
	-0.85%	4.52%	4.72%	3.58%	2.74%	1.91%	1.13%	0.69%	0.50%
	-0.73%	2.85%	2.87%	0.79%	0.04%	-0.16%	0.05%	0.19%	0.35%
16 COMBINATIONS	-0.12%	2.77%	2.85%	2.79%	3.11%	2.19%	1.27%	0.64%	0.30%
RALSTON									
MEAN	**-0.58%**	**1.44%**	**0.81%**	**0.14%**	**0.15%**	**0.18%**	**0.22%**	**0.16%**	**0.12%**
STD. DEV.	**0.57%**	**1.77%**	**1.80%**	**2.30%**	**2.12%**	**1.72%**	**1.01%**	**0.54%**	**0.29%**

VALCO (16 COMBINATIONS)

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
	0.00%	-3.98%	-1.69%	-1.89%	-2.39%	-2.26%	-0.75%	-0.14%	-0.03%
	0.49%	-2.21%	0.89%	0.13%	-0.05%	0.02%	0.45%	0.37%	0.20%
	0.24%	-3.72%	-1.57%	-2.43%	-3.64%	-3.45%	-1.29%	-0.43%	-0.29%
	0.00%	-1.12%	-0.14%	-0.94%	-1.85%	-1.48%	-0.14%	0.25%	0.16%
	0.11%	-0.97%	1.45%	2.55%	3.20%	2.98%	1.77%	0.77%	0.31%
	-0.14%	-2.48%	-1.00%	-0.01%	-0.39%	-0.49%	0.04%	-0.03%	-0.18%
	-0.38%	0.13%	0.43%	1.48%	1.40%	1.48%	1.19%	0.65%	0.29%
	-0.38%	-2.74%	-1.12%	0.53%	0.86%	0.70%	0.57%	0.26%	0.07%
	-0.21%	-0.12%	-1.22%	-1.23%	-2.43%	-2.65%	-1.20%	-0.48%	-0.28%
	-0.45%	2.48%	0.21%	0.26%	-0.64%	-0.68%	-0.04%	0.20%	0.19%
	-0.45%	-0.39%	-1.34%	-0.69%	-1.18%	-1.46%	-0.66%	-0.19%	-0.03%
	0.04%	1.38%	1.23%	1.33%	1.16%	0.82%	0.54%	0.32%	0.21%
	0.00%	3.88%	4.64%	3.77%	1.83%	1.09%	0.70%	0.49%	0.23%
	0.00%	1.02%	3.09%	2.82%	1.29%	0.31%	0.08%	0.10%	0.02%
	0.49%	2.79%	5.66%	4.84%	3.63%	2.59%	1.28%	0.61%	0.26%
16 COMBINATIONS	0.24%	1.28%	3.21%	2.28%	0.04%	-0.88%	-0.46%	-0.19%	-0.23%
VALCO									
MEAN	**-0.03%**	**-0.30%**	**0.80%**	**0.80%**	**0.05%**	**-0.21%**	**0.13%**	**0.16%**	**0.06%**
STD. DEV.	**0.30%**	**2.35%**	**2.29%**	**2.06%**	**2.04%**	**1.81%**	**0.88%**	**0.38%**	**0.21%**

FRANCISCOTTI

EXPERIMENTAL - CONTROL

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
596-1	99.49%	71.45%	46.37%	32.88%	24.16%	17.23%	11.32%	7.27%	4.53%	EXP.
596X-5	99.59%	67.61%	42.44%	30.68%	22.43%	15.40%	9.78%	6.16%	3.78%	CONTROL
% DIFF	-0.10%	3.83%	3.93%	2.20%	1.73%	1.83%	1.54%	1.10%	0.75%	
596X-2	99.41%	69.52%	45.01%	33.65%	24.84%	17.34%	11.30%	7.35%	4.73%	EXP.
596X-6	100.00%	70.25%	44.52%	33.86%	26.36%	19.04%	12.45%	7.88%	4.80%	CONTROL
% DIFF	-0.59%	-0.73%	0.49%	-0.21%	-1.52%	-1.71%	-1.15%	-0.53%	-0.07%	
596X-3	99.73%	70.47%	46.14%	33.72%	24.46%	16.77%	10.82%	6.98%	4.38%	EXP.
596X-7	100.00%	69.59%	44.26%	31.81%	23.13%	16.02%	10.40%	6.75%	4.25%	CONTROL
% DIFF	-0.27%	0.88%	1.88%	1.91%	1.34%	0.75%	0.41%	0.23%	0.12%	
596X-4	100.00%	70.66%	45.83%	34.17%	25.69%	18.11%	11.83%	7.59%	4.76%	EXP.
596X-8	99.72%	71.11%	47.45%	35.91%	26.94%	18.78%	12.00%	7.58%	4.69%	CONTROL
% DIFF	0.28%	-0.46%	-1.62%	-1.74%	-1.25%	-0.67%	-0.17%	0.01%	0.07%	

FRANCISCOTTI

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
596X-1	99.49%	71.45%	46.37%	32.88%	24.16%	17.23%	11.32%	7.27%	4.53%	EXP.
596X-6	100.00%	70.25%	44.52%	33.86%	26.36%	19.04%	12.45%	7.88%	4.80%	CONTROL
% DIFF	-0.51%	1.20%	1.85%	-0.98%	-2.20%	-1.81%	-1.13%	-0.61%	-0.27%	
596X-2	99.41%	69.52%	45.01%	33.65%	24.84%	17.34%	11.30%	7.35%	4.73%	EXP.
596X-7	100.00%	69.59%	44.26%	31.81%	23.13%	16.02%	10.40%	6.75%	4.25%	CONTROL
% DIFF	-0.59%	-0.07%	0.75%	1.84%	1.72%	1.32%	0.90%	0.60%	0.48%	
596X-3	99.73%	70.47%	46.14%	33.72%	24.46%	16.77%	10.82%	6.98%	4.38%	EXP.
596X-8	99.72%	71.11%	47.45%	35.91%	26.94%	18.78%	12.00%	7.58%	4.69%	CONTROL
% DIFF	0.00%	-0.65%	-1.32%	-2.19%	-2.47%	-2.00%	-1.18%	-0.60%	-0.32%	
596X-4	100.00%	70.66%	45.83%	34.17%	25.69%	18.11%	11.83%	7.59%	4.76%	EXP.
596X-5	99.59%	67.61%	42.44%	30.68%	22.43%	15.40%	9.78%	6.16%	3.78%	CONTROL
% DIFF	0.41%	3.04%	3.40%	3.49%	3.25%	2.71%	2.04%	1.42%	0.98%	

RALSTON

SIEVE SIZE	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-1	97.60%	79.72%	65.03%	41.77%	27.93%	18.37%	10.02%	5.62%	3.01%	EXP.
non-NCAT-5	99.08%	77.93%	64.19%	39.97%	25.14%	15.68%	8.22%	4.54%	2.43%	CONTROL
% DIFF	-1.48%	1.79%	0.84%	1.80%	2.80%	2.70%	1.81%	1.07%	0.58%	
NCAT-2	98.76%	81.80%	66.62%	41.02%	26.01%	16.29%	8.48%	4.65%	2.44%	EXP.
non-NCAT-6	98.96%	79.61%	66.04%	42.76%	27.84%	17.75%	9.30%	5.04%	2.59%	CONTROL
% DIFF	-0.20%	2.19%	0.58%	-1.74%	-1.83%	-1.46%	-0.82%	-0.39%	-0.15%	
NCAT-3	98.11%	80.78%	65.69%	40.10%	24.91%	15.42%	8.09%	4.55%	2.56%	EXP.
non-NCAT-7	99.08%	79.69%	66.05%	39.76%	24.77%	15.39%	8.08%	4.60%	2.63%	CONTROL
% DIFF	-0.97%	1.09%	-0.36%	0.33%	0.14%	0.03%	0.01%	-0.05%	-0.08%	
NCAT-4	98.23%	82.45%	68.90%	43.55%	27.88%	17.59%	9.35%	5.24%	2.93%	EXP.
non-NCAT-8	98.69%	81.77%	66.71%	43.18%	28.40%	18.15%	9.48%	5.22%	2.83%	CONTROL
% DIFF	-0.47%	0.69%	2.20%	0.38%	-0.52%	-0.57%	-0.13%	0.01%	0.10%	

SIEVE SIZE	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-1	97.60%	79.72%	65.03%	41.77%	27.93%	18.37%	10.02%	5.62%	3.01%	EXP.
non-NCAT-6	98.96%	79.61%	66.04%	42.76%	27.84%	17.75%	9.30%	5.04%	2.59%	CONTROL
% DIFF	-1.36%	0.11%	-1.01%	-0.99%	0.09%	0.63%	0.73%	0.57%	0.43%	
NCAT-2	98.76%	81.80%	66.62%	41.02%	26.01%	16.29%	8.48%	4.65%	2.44%	EXP.
non-NCAT-7	99.08%	79.69%	66.05%	39.76%	24.77%	15.39%	8.08%	4.60%	2.63%	CONTROL
% DIFF	-0.32%	2.11%	0.57%	1.26%	1.24%	0.90%	0.40%	0.05%	-0.19%	
NCAT-3	98.11%	80.78%	65.69%	40.10%	24.91%	15.42%	8.09%	4.55%	2.56%	EXP.
non-NCAT-8	98.69%	81.77%	66.71%	43.18%	28.40%	18.15%	9.48%	5.22%	2.83%	CONTROL
% DIFF	-0.58%	-0.99%	-1.02%	-3.08%	-3.49%	-2.73%	-1.39%	-0.68%	-0.27%	
NCAT-4	98.23%	82.45%	68.90%	43.55%	27.88%	17.59%	9.35%	5.24%	2.93%	EXP.
non-NCAT-5	99.08%	77.93%	64.19%	39.97%	25.14%	15.68%	8.22%	4.54%	2.43%	CONTROL
% DIFF	-0.85%	4.52%	4.72%	3.58%	2.74%	1.91%	1.13%	0.69%	0.50%	

VALCO/ROCKY MOUNTAIN/CAS PIT:

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-1	100.00%	71.69%	60.00%	43.43%	33.15%	24.23%	11.29%	4.86%	2.75%	EXP.
NON NCAT-5	100.00%	75.67%	61.68%	45.32%	35.54%	26.49%	12.05%	5.00%	2.78%	CONTROL
% DIFF	0.00%	-3.98%	-1.69%	-1.89%	-2.39%	-2.26%	-0.75%	-0.14%	-0.03%	
NCAT-2	99.62%	72.94%	60.56%	45.85%	36.40%	27.19%	12.62%	5.26%	2.85%	EXP.
NON NCAT-6	99.51%	73.90%	59.11%	43.30%	33.20%	24.21%	10.84%	4.49%	2.54%	CONTROL
	0.11%	-0.97%	1.45%	2.55%	3.20%	2.98%	1.77%	0.77%	0.31%	
NCAT-3	99.55%	75.29%	60.34%	44.62%	34.36%	25.03%	11.39%	4.81%	2.75%	EXP.
NON NCAT-7	99.76%	75.41%	61.56%	45.86%	36.79%	27.68%	12.58%	5.29%	3.03%	CONTROL
	-0.21%	-0.12%	-1.22%	-1.23%	-2.43%	-2.65%	-1.20%	-0.48%	-0.28%	
NCAT-4	100.00%	76.69%	64.77%	48.14%	36.83%	26.80%	12.13%	5.10%	2.80%	EXP.
NON NCAT-8	100.00%	72.81%	60.13%	44.37%	35.00%	25.71%	11.43%	4.61%	2.56%	CONTROL
	0.00%	3.88%	4.64%	3.77%	1.83%	1.09%	0.70%	0.49%	0.23%	

SIEVE SIZE	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-1	100.00%	71.69%	60.00%	43.43%	33.15%	24.23%	11.29%	4.86%	2.75%	EXP.
non-NCAT-6	99.51%	73.90%	59.11%	43.30%	33.20%	24.21%	10.84%	4.49%	2.54%	CONTROL
% DIFF	0.49%	-2.21%	0.89%	0.13%	-0.05%	0.02%	0.45%	0.37%	0.20%	
NCAT-2	99.62%	72.94%	60.56%	45.85%	36.40%	27.19%	12.62%	5.26%	2.85%	EXP.
non-NCAT-7	99.76%	75.41%	61.56%	45.86%	36.79%	27.68%	12.58%	5.29%	3.03%	CONTROL
% DIFF	-0.14%	-2.48%	-1.00%	-0.01%	-0.39%	-0.49%	0.04%	-0.03%	-0.18%	
NCAT-3	99.55%	75.29%	60.34%	44.62%	34.36%	25.03%	11.39%	4.81%	2.75%	EXP.
non-NCAT-8	100.00%	72.81%	60.13%	44.37%	35.00%	25.71%	11.43%	4.61%	2.56%	CONTROL
% DIFF	-0.45%	2.48%	0.21%	0.26%	-0.64%	-0.68%	-0.04%	0.20%	0.19%	
NCAT-4	100.00%	76.69%	64.77%	48.14%	36.83%	26.80%	12.13%	5.10%	2.80%	EXP.
non-NCAT-5	100.00%	75.67%	61.68%	45.32%	35.54%	26.49%	12.05%	5.00%	2.78%	CONTROL
% DIFF	0.00%	1.02%	3.09%	2.82%	1.29%	0.31%	0.08%	0.10%	0.02%	

Irwin Windsor/Stute Pit:

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-1	99.78%	79.98%	58.65%	44.50%	33.76%	24.42%	15.79%	9.73%	6.10%	EXP
NON NCAT-5	100.00%	80.67%	59.97%	43.01%	31.60%	22.14%	13.88%	8.29%	4.99%	CONTROL
% DIFF	-0.22%	-0.68%	-1.32%	1.49%	2.16%	2.28%	1.90%	1.44%	1.11%	
NCAT-2	99.45%	82.21%	60.11%	42.64%	30.06%	20.80%	13.37%	8.47%	5.59%	EXP
NON NCAT-6	99.70%	81.64%	60.27%	44.14%	31.81%	22.03%	13.90%	8.57%	5.49%	CONTROL
% DIFF	-0.26%	0.56%	-0.16%	-1.50%	-1.75%	-1.23%	-0.54%	-0.10%	0.11%	
NCAT-3	100.00%	78.89%	58.50%	42.87%	31.01%	21.76%	14.02%	8.76%	5.59%	EXP
NON NCAT-7	100.00%	75.87%	56.65%	42.17%	30.19%	20.18%	12.33%	7.46%	4.67%	CONTROL
% DIFF	0.00%	3.02%	1.85%	0.71%	0.81%	1.59%	1.69%	1.30%	0.91%	
NCAT-4	100.00%	79.60%	60.78%	45.63%	33.53%	23.71%	15.34%	9.66%	6.25%	EXP
NON NCAT-8	99.40%	80.37%	60.86%	44.82%	33.32%	23.51%	14.71%	8.82%	5.34%	CONTROL
% DIFF	0.60%	-0.77%	-0.08%	0.81%	0.21%	0.20%	0.63%	0.84%	0.90%	

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-1	99.78%	79.98%	58.65%	44.50%	33.76%	24.42%	15.79%	9.73%	6.10%	EXP
non-NCAT-6	99.70%	81.64%	60.27%	44.14%	31.81%	22.03%	13.90%	8.57%	5.49%	CONTROL
% DIFF	0.08%	-1.66%	-1.62%	0.35%	1.95%	2.39%	1.88%	1.16%	0.61%	
NCAT-2	99.45%	82.21%	60.11%	42.64%	30.06%	20.80%	13.37%	8.47%	5.59%	EXP
non-NCAT-7	100.00%	75.87%	56.65%	42.17%	30.19%	20.18%	12.33%	7.46%	4.67%	CONTROL
% DIFF	-0.55%	6.33%	3.46%	0.48%	-0.14%	0.62%	1.04%	1.01%	0.92%	
NCAT-3	100.00%	78.89%	58.50%	42.87%	31.01%	21.76%	14.02%	8.76%	5.59%	EXP
non-NCAT-8	99.40%	80.37%	60.86%	44.82%	33.32%	23.51%	14.71%	8.82%	5.34%	CONTROL
% DIFF	0.60%	-1.48%	-2.36%	-1.95%	-2.31%	-1.74%	-0.69%	-0.06%	0.24%	
NCAT-4	100.00%	79.60%	60.78%	45.63%	33.53%	23.71%	15.34%	9.66%	6.25%	EXP
non-NCAT-5	100.00%	80.67%	59.97%	43.01%	31.60%	22.14%	13.88%	8.29%	4.99%	CONTROL
% DIFF	0.00%	-1.06%	0.81%	2.62%	1.93%	1.56%	1.46%	1.37%	1.26%	

FRANCISCOTTI

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
596X-1	99.49%	71.45%	46.37%	32.88%	24.16%	17.23%	11.32%	7.27%	4.53%	EXP.
596X-7	100.00%	69.59%	44.26%	31.81%	23.13%	16.02%	10.40%	6.75%	4.25%	CONTROL
% DIFF.	-0.51%	1.86%	2.11%	1.07%	1.04%	1.21%	0.92%	0.52%	0.28%	
596X-2	99.41%	69.52%	45.01%	33.65%	24.84%	17.34%	11.30%	7.35%	4.73%	EXP.
596X-8	99.72%	71.11%	47.45%	35.91%	26.94%	18.78%	12.00%	7.58%	4.69%	CONTROL
% DIFF.	-0.31%	-1.60%	-2.45%	-2.26%	-2.10%	-1.44%	-0.69%	-0.23%	0.04%	
596X-3	99.73%	70.47%	46.14%	33.72%	24.46%	16.77%	10.82%	6.98%	4.38%	EXP.
596X-5	99.59%	67.61%	42.44%	30.68%	22.43%	15.40%	9.78%	6.16%	3.78%	CONTROL
% DIFF.	0.14%	2.85%	3.70%	3.03%	2.03%	1.37%	1.03%	0.81%	0.59%	
596X-4	100.00%	70.66%	45.83%	34.17%	25.69%	18.11%	11.83%	7.59%	4.76%	EXP.
596X-6	100.00%	70.25%	44.52%	33.86%	26.36%	19.04%	12.45%	7.88%	4.80%	CONTROL
% DIFF.	0.00%	0.41%	1.31%	0.31%	-0.67%	-0.93%	-0.62%	-0.29%	-0.04%	

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
596X-1	99.49%	71.45%	46.37%	32.88%	24.16%	17.23%	11.32%	7.27%	4.53%	EXP.
596X-8	99.72%	71.11%	47.45%	35.91%	26.94%	18.78%	12.00%	7.58%	4.69%	CONTROL
% DIFF.	-0.23%	0.33%	-1.09%	-3.03%	-2.78%	-1.55%	-0.67%	-0.31%	-0.16%	
596X-2	99.41%	69.52%	45.01%	33.65%	24.84%	17.34%	11.30%	7.35%	4.73%	EXP.
596X-5	99.59%	67.61%	42.44%	30.68%	22.43%	15.40%	9.78%	6.16%	3.78%	CONTROL
% DIFF.	-0.18%	1.90%	2.57%	2.96%	2.41%	1.94%	1.52%	1.19%	0.95%	
596X-3	99.73%	70.47%	46.14%	33.72%	24.46%	16.77%	10.82%	6.98%	4.38%	EXP.
596X-6	100.00%	70.25%	44.52%	33.86%	26.36%	19.04%	12.45%	7.88%	4.80%	CONTROL
% DIFF.	-0.27%	0.22%	1.62%	-0.14%	-1.90%	-2.27%	-1.63%	-0.90%	-0.42%	
596X-4	100.00%	70.66%	45.83%	34.17%	25.69%	18.11%	11.83%	7.59%	4.76%	EXP.
596X-7	100.00%	69.59%	44.26%	31.81%	23.13%	16.02%	10.40%	6.75%	4.25%	CONTROL
% DIFF.	0.00%	1.07%	1.57%	2.36%	2.56%	2.09%	1.42%	0.84%	0.51%	

RALSTON

SIEVE SIZE	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-1	97.60%	79.72%	65.03%	41.77%	27.93%	18.37%	10.02%	5.62%	3.01%	EXP.
non-NCAT-7	99.08%	79.69%	66.05%	39.76%	24.77%	15.39%	8.08%	4.60%	2.63%	CONTROL
% DIFF	-1.48%	0.04%	-1.02%	2.01%	3.16%	2.98%	1.94%	1.02%	0.38%	
NCAT-2	98.76%	81.80%	66.62%	41.02%	26.01%	16.29%	8.48%	4.65%	2.44%	EXP.
non-NCAT-8	98.69%	81.77%	66.71%	43.18%	28.40%	18.15%	9.48%	5.22%	2.83%	CONTROL
% DIFF	0.06%	0.03%	-0.09%	-2.16%	-2.39%	-1.86%	-1.00%	-0.57%	-0.39%	
NCAT-3	98.11%	80.78%	65.69%	40.10%	24.91%	15.42%	8.09%	4.55%	2.56%	EXP.
non-NCAT-5	99.08%	77.93%	64.19%	39.97%	25.14%	15.68%	8.22%	4.54%	2.43%	CONTROL
% DIFF	-0.97%	2.84%	1.50%	0.12%	-0.22%	-0.25%	-0.13%	0.00%	0.13%	
NCAT-4	98.23%	82.45%	68.90%	43.55%	27.88%	17.59%	9.35%	5.24%	2.93%	EXP.
non-NCAT-6	98.96%	79.61%	66.04%	42.76%	27.84%	17.75%	9.30%	5.04%	2.59%	CONTROL
% DIFF	-0.73%	2.85%	2.87%	0.79%	0.04%	-0.16%	0.05%	0.19%	0.35%	

SIEVE SIZE	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-1	97.60%	79.72%	65.03%	41.77%	27.93%	18.37%	10.02%	5.62%	3.01%	EXP.
non-NCAT-8	98.69%	81.77%	66.71%	43.18%	28.40%	18.15%	9.48%	5.22%	2.83%	CONTROL
% DIFF.	-1.09%	-2.04%	-1.68%	-1.40%	-0.47%	0.22%	0.54%	0.39%	0.18%	
NCAT-2	98.76%	81.80%	66.62%	41.02%	26.01%	16.29%	8.48%	4.65%	2.44%	EXP.
non-NCAT-5	99.08%	77.93%	64.19%	39.97%	25.14%	15.68%	8.22%	4.54%	2.43%	CONTROL
% DIFF.	-0.32%	3.87%	2.43%	1.05%	0.88%	0.61%	0.26%	0.11%	0.01%	
NCAT-3	98.11%	80.78%	65.69%	40.10%	24.91%	15.42%	8.09%	4.55%	2.56%	EXP.
non-NCAT-6	98.96%	79.61%	66.04%	42.76%	27.84%	17.75%	9.30%	5.04%	2.59%	CONTROL
% DIFF.	-0.85%	1.17%	-0.35%	-2.67%	-2.93%	-2.32%	-1.21%	-0.49%	-0.03%	
NCAT-4	98.23%	82.45%	68.90%	43.55%	27.88%	17.59%	9.35%	5.24%	2.93%	EXP.
non-NCAT-7	99.08%	79.69%	66.05%	39.76%	24.77%	15.39%	8.08%	4.60%	2.63%	CONTROL
% DIFF.	-0.86%	2.77%	2.85%	3.79%	3.11%	2.19%	1.27%	0.64%	0.30%	

VALCO/ROCKY MOUNTAIN/CAS PIT:

SIEVE SIZE	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-1	100.00%	71.69%	60.00%	43.43%	33.15%	24.23%	11.29%	4.86%	2.75%	EXP.
non-NCAT-7	99.76%	75.41%	61.56%	45.86%	36.79%	27.68%	12.58%	5.29%	3.03%	CONTROL
% DIFF	0.24%	-3.72%	-1.57%	-2.43%	-3.64%	-3.45%	-1.29%	-0.43%	-0.29%	
NCAT-2	99.62%	72.94%	60.56%	45.85%	36.40%	27.19%	12.62%	5.26%	2.85%	EXP.
non-NCAT-8	100.00%	72.81%	60.13%	44.37%	35.00%	25.71%	11.43%	4.61%	2.56%	CONTROL
% DIFF	-0.38%	0.13%	0.43%	1.48%	1.40%	1.48%	1.19%	0.65%	0.29%	
NCAT-3	99.55%	75.29%	60.34%	44.62%	34.36%	25.03%	11.39%	4.81%	2.75%	EXP.
non-NCAT-5	100.00%	75.67%	61.68%	45.32%	35.54%	26.49%	12.05%	5.00%	2.78%	CONTROL
% DIFF	-0.45%	-0.39%	-1.34%	-0.69%	-1.18%	-1.46%	-0.66%	-0.19%	-0.03%	
NCAT-4	100.00%	76.69%	64.77%	48.14%	36.83%	26.80%	12.13%	5.10%	2.80%	EXP.
non-NCAT-6	99.51%	73.90%	59.11%	43.30%	33.20%	24.21%	10.84%	4.49%	2.54%	CONTROL
% DIFF	0.49%	2.79%	5.66%	4.84%	3.63%	2.59%	1.28%	0.61%	0.26%	

SIEVE SIZE	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-1	100.00%	71.69%	60.00%	43.43%	33.15%	24.23%	11.29%	4.86%	2.75%	EXP.
non-NCAT-8	100.00%	72.81%	60.13%	44.37%	35.00%	25.71%	11.43%	4.61%	2.56%	CONTROL
% DIFF.	0.00%	-1.12%	-0.14%	-0.94%	-1.85%	-1.48%	-0.14%	0.25%	0.18%	
NCAT-2	99.62%	72.94%	60.56%	45.85%	36.40%	27.19%	12.62%	5.26%	2.85%	EXP.
non-NCAT-5	100.00%	75.67%	61.68%	45.32%	35.54%	26.49%	12.05%	5.00%	2.78%	CONTROL
% DIFF.	-0.38%	-2.74%	-1.12%	0.53%	0.86%	0.70%	0.57%	0.26%	0.07%	
NCAT-3	99.55%	75.29%	60.34%	44.62%	34.36%	25.03%	11.39%	4.81%	2.75%	EXP.
non-NCAT-6	99.51%	73.90%	59.11%	43.30%	33.20%	24.21%	10.84%	4.49%	2.54%	CONTROL
% DIFF.	0.04%	1.38%	1.23%	1.33%	1.16%	0.82%	0.54%	0.32%	0.21%	
NCAT-4	100.00%	76.69%	64.77%	48.14%	36.83%	26.80%	12.13%	5.10%	2.80%	EXP.
non-NCAT-7	99.76%	75.41%	61.56%	45.86%	36.79%	27.68%	12.58%	5.29%	3.03%	CONTROL
% DIFF.	0.24%	1.28%	3.21%	2.28%	0.04%	-0.88%	-0.46%	-0.19%	-0.23%	

Irwin Windsor/Stute Pit:

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-1	99.78%	79.98%	58.65%	44.50%	33.76%	24.42%	15.79%	9.73%	6.10%	EXP
non-NCAT-7	100.00%	75.87%	56.65%	42.17%	30.19%	20.18%	12.33%	7.46%	4.67%	CONTROL
% DIFF	-0.22%	4.11%	2.00%	2.33%	3.57%	4.24%	3.46%	2.27%	1.43%	
NCAT-2	99.45%	82.21%	60.11%	42.64%	30.06%	20.80%	13.37%	8.47%	5.59%	EXP
non-NCAT-8	99.40%	80.37%	60.86%	44.82%	33.32%	23.51%	14.71%	8.82%	5.34%	CONTROL
% DIFF	0.04%	1.83%	-0.75%	-2.18%	-3.26%	-2.71%	-1.34%	-0.35%	0.25%	
NCAT-3	100.00%	78.89%	58.50%	42.87%	31.01%	21.76%	14.02%	8.76%	5.59%	EXP
non-NCAT-5	100.00%	80.67%	59.97%	43.01%	31.60%	22.14%	13.88%	8.29%	4.99%	CONTROL
% DIFF	0.00%	-1.77%	-1.46%	-0.13%	-0.60%	-0.38%	0.13%	0.47%	0.60%	
NCAT-4	100.00%	79.60%	60.78%	45.63%	33.53%	23.71%	15.34%	9.66%	6.25%	EXP
non-NCAT-6	99.70%	81.64%	60.27%	44.14%	31.81%	22.03%	13.90%	8.57%	5.49%	CONTROL
% DIFF	0.30%	-2.04%	0.51%	1.49%	1.72%	1.68%	1.44%	1.09%	0.76%	

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-1	99.78%	79.98%	58.65%	44.50%	33.76%	24.42%	15.79%	9.73%	6.10%	EXP
non-NCAT-8	99.40%	80.37%	60.86%	44.82%	33.32%	23.51%	14.71%	8.82%	5.34%	CONTROL
% DIFF.	0.37%	-0.39%	-2.21%	-0.33%	0.44%	0.91%	1.08%	0.91%	0.75%	
NCAT-2	99.45%	82.21%	60.11%	42.64%	30.06%	20.80%	13.37%	8.47%	5.59%	EXP
non-NCAT-5	100.00%	80.67%	59.97%	43.01%	31.60%	22.14%	13.88%	8.29%	4.99%	CONTROL
% DIFF.	-0.55%	1.54%	0.15%	-0.36%	-1.55%	-1.34%	-0.52%	0.18%	0.61%	
NCAT-3	100.00%	78.89%	58.50%	42.87%	31.01%	21.76%	14.02%	8.76%	5.59%	EXP
non-NCAT-6	99.70%	81.64%	60.27%	44.14%	31.81%	22.03%	13.90%	8.57%	5.49%	CONTROL
% DIFF.	0.30%	-2.75%	-1.76%	-1.27%	-0.80%	-0.26%	0.11%	0.19%	0.10%	
NCAT-4	100.00%	79.60%	60.78%	45.63%	33.53%	23.71%	15.34%	9.66%	6.25%	EXP
non-NCAT-7	100.00%	75.87%	56.65%	42.17%	30.19%	20.18%	12.33%	7.46%	4.67%	CONTROL
% DIFF.	0.00%	3.73%	4.13%	3.46%	3.34%	3.53%	3.01%	2.20%	1.57%	

MONK PIT:

SIEVE SIZE	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-1	99.47%	82.21%	62.56%	38.03%	25.14%	17.44%	11.11%	6.52%	3.17%	EXP
NON NCAT-5	99.50%	80.09%	62.74%	41.40%	28.90%	20.54%	13.15%	7.66%	3.72%	CONTROL
% DIFF	-0.03%	2.12%	-0.18%	-3.37%	-3.76%	-3.10%	-2.04%	-1.14%	-0.55%	
NCAT-2	98.53%	83.61%	65.02%	42.68%	30.80%	22.54%	14.76%	9.57%	7.91%	EXP
NON NCAT-6	99.24%	78.83%	63.42%	43.15%	31.60%	23.12%	14.77%	8.27%	3.63%	CONTROL
% DIFF	-0.71%	4.78%	1.59%	-0.47%	-0.80%	-0.59%	-0.02%	1.30%	4.27%	
NCAT-3	99.16%	81.68%	64.78%	43.70%	31.90%	23.41%	14.84%	7.91%	3.14%	EXP
NON NCAT-7	98.59%	82.73%	66.32%	42.41%	28.37%	19.66%	12.50%	7.28%	3.55%	CONTROL
% DIFF	0.57%	-1.05%	-1.55%	1.29%	3.53%	3.74%	2.34%	0.63%	-0.41%	
NCAT-4	100.00%	80.47%	64.06%	42.26%	29.88%	21.37%	13.44%	7.38%	3.15%	EXP
NON NCAT-8	99.50%	79.58%	63.54%	42.81%	30.48%	21.81%	13.73%	7.66%	3.23%	CONTROL
% DIFF	0.50%	0.89%	0.52%	-0.54%	-0.60%	-0.45%	-0.29%	-0.28%	-0.09%	

PAGOSA TROUT LAKES

15 POSSIBLE COMBINATIONS

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-4	100.00%	76.34%	52.40%	35.85%	25.35%	18.28%	12.53%	8.36%	5.83%	EXP
Non NCAT-1	99.74%	73.50%	46.45%	33.26%	22.75%	16.09%	11.09%	7.57%	5.33%	CONTROL
% DIFF	0.26%	2.84%	5.94%	2.59%	2.60%	2.19%	1.44%	0.79%	0.49%	
NCAT-5	100.00%	74.63%	50.46%	37.59%	27.07%	19.71%	13.81%	9.44%	6.61%	EXP
Non NCAT-2	99.80%	76.99%	54.75%	41.27%	29.60%	21.25%	14.52%	9.64%	6.63%	CONTROL
% DIFF	0.20%	-2.36%	-4.29%	-3.68%	-2.53%	-1.54%	-0.71%	-0.20%	-0.02%	
NCAT-6	100.00%	75.65%	51.00%	36.76%	25.63%	18.29%	12.65%	8.59%	5.94%	EXP
Non NCAT-3	99.46%	72.27%	47.95%	32.01%	22.27%	15.76%	10.59%	6.97%	4.74%	CONTROL
% DIFF	0.54%	3.38%	3.05%	4.75%	3.36%	2.54%	2.06%	1.62%	1.20%	

SIEVE SIZE	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-1	99.47%	82.21%	62.56%	38.03%	25.14%	17.44%	11.11%	6.52%	3.17%	EXP
non-NCAT-6	99.24%	78.83%	63.42%	43.15%	31.60%	23.12%	14.77%	8.27%	3.63%	CONTROL
% DIFF	0.24%	3.38%	-0.86%	-5.11%	-6.46%	-5.69%	-3.66%	-1.74%	-0.46%	
NCAT-2	98.53%	83.61%	65.02%	42.68%	30.80%	22.54%	14.76%	9.57%	7.91%	EXP
non-NCAT-7	98.59%	82.73%	66.32%	42.41%	28.37%	19.66%	12.50%	7.28%	3.55%	CONTROL
% DIFF	-0.06%	0.88%	-1.31%	0.27%	2.43%	2.87%	2.26%	2.29%	4.36%	
NCAT-3	99.16%	81.68%	64.78%	43.70%	31.90%	23.41%	14.84%	7.91%	3.14%	EXP
non-NCAT-8	99.50%	79.58%	63.54%	42.81%	30.48%	21.81%	13.73%	7.66%	3.23%	CONTROL
% DIFF	-0.33%	2.10%	1.24%	0.89%	1.42%	1.59%	1.11%	0.26%	-0.09%	
NCAT-4	100.00%	80.47%	64.06%	42.26%	29.88%	21.37%	13.44%	7.38%	3.15%	EXP
non-NCAT-5	99.50%	80.09%	62.74%	41.40%	28.90%	20.54%	13.15%	7.66%	3.72%	CONTROL
% DIFF	0.50%	0.37%	1.32%	0.87%	0.98%	0.83%	0.29%	-0.28%	-0.58%	

PAGOSA TROUT LAKES

15 POSSIBLE COMBINATIONS

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-4	100.00%	76.34%	52.40%	35.85%	25.35%	18.28%	12.53%	8.36%	5.83%	EXP
Non NCAT-3	99.46%	72.27%	47.95%	32.01%	22.27%	15.76%	10.59%	6.97%	4.74%	CONTROL
% DIFF	0.54%	4.07%	4.45%	3.84%	3.09%	2.53%	1.94%	1.39%	1.09%	
NCAT-5	100.00%	74.63%	50.46%	37.59%	27.07%	19.71%	13.81%	9.44%	6.61%	EXP
Non NCAT-1	99.74%	73.50%	46.45%	33.26%	22.75%	16.09%	11.09%	7.57%	5.33%	CONTROL
% DIFF	0.26%	1.13%	4.01%	4.33%	4.32%	3.62%	2.72%	1.87%	1.27%	
NCAT-6	100.00%	75.65%	51.00%	36.76%	25.63%	18.29%	12.65%	8.59%	5.94%	EXP
Non NCAT-2	99.80%	76.99%	54.75%	41.27%	29.60%	21.25%	14.52%	9.64%	6.63%	CONTROL
% DIFF	0.20%	-1.34%	-3.75%	-4.51%	-3.97%	-2.96%	-1.87%	-1.05%	-0.69%	

MONK PIT:

SIEVE SIZE	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-1	99.47%	82.21%	62.56%	38.03%	25.14%	17.44%	11.11%	6.52%	3.17%	EXP
non-NCAT-7	98.59%	82.73%	66.32%	42.41%	28.37%	19.66%	12.50%	7.28%	3.55%	CONTROL
% DIFF	0.88%	-0.52%	-3.76%	-4.38%	-3.23%	-2.23%	-1.39%	-0.76%	-0.38%	
NCAT-2	98.53%	83.61%	65.02%	42.68%	30.80%	22.54%	14.76%	9.57%	7.91%	EXP
non-NCAT-8	99.50%	79.58%	63.54%	42.81%	30.48%	21.81%	13.73%	7.66%	3.23%	CONTROL
% DIFF	-0.97%	4.04%	1.48%	-0.13%	0.32%	0.72%	1.03%	1.91%	4.67%	
NCAT-3	99.16%	81.68%	64.78%	43.70%	31.90%	23.41%	14.84%	7.91%	3.14%	EXP
non-NCAT-5	99.50%	80.09%	62.74%	41.40%	28.90%	20.54%	13.15%	7.66%	3.72%	CONTROL
% DIFF	-0.34%	1.59%	2.04%	2.30%	3.00%	2.87%	1.69%	0.25%	-0.58%	
NCAT-4	100.00%	80.47%	64.06%	42.26%	29.88%	21.37%	13.44%	7.38%	3.15%	EXP
non-NCAT-6	99.24%	78.83%	63.42%	43.15%	31.60%	23.12%	14.77%	8.27%	3.63%	CONTROL
% DIFF	0.76%	1.64%	0.64%	-0.88%	-1.72%	-1.76%	-1.34%	-0.89%	-0.49%	

PAGOSA TROUT LAKES **15 POSSIBLE COMBINATIONS**

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-4	100.00%	76.34%	52.40%	35.85%	25.35%	18.28%	12.53%	8.36%	5.83%	EXP
Non NCAT-2	99.80%	76.99%	54.75%	41.27%	29.60%	21.25%	14.52%	9.64%	6.63%	CONTROL
% DIFF	0.20%	-0.65%	-2.35%	-5.42%	-4.25%	-2.97%	-1.99%	-1.27%	-0.80%	
NCAT-5	100.00%	74.63%	50.46%	37.59%	27.07%	19.71%	13.81%	9.44%	6.61%	EXP
Non NCAT-3	99.46%	72.27%	47.95%	32.01%	22.27%	15.76%	10.59%	6.97%	4.74%	CONTROL
% DIFF	0.54%	2.36%	2.52%	5.58%	4.81%	3.95%	3.22%	2.47%	1.87%	
NCAT-6	100.00%	75.65%	51.00%	36.76%	25.63%	18.29%	12.65%	8.59%	5.94%	EXP
Non NCAT-1	99.74%	73.50%	46.45%	33.26%	22.75%	16.09%	11.09%	7.57%	5.33%	CONTROL
% DIFF	0.26%	2.15%	4.54%	3.50%	2.88%	2.20%	1.56%	1.02%	0.61%	

SIEVE SIZE	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-1	99.47%	82.21%	62.56%	38.03%	25.14%	17.44%	11.11%	6.52%	3.17%	EXP
non-NCAT-8	99.50%	79.58%	63.54%	42.81%	30.48%	21.81%	13.73%	7.66%	3.23%	CONTROL
% DIFF	-0.02%	2.63%	-0.98%	-4.78%	-5.34%	-4.38%	-2.62%	-1.13%	-0.06%	
NCAT-2	98.53%	83.61%	65.02%	42.68%	30.80%	22.54%	14.76%	9.57%	7.91%	EXP
non-NCAT-5	99.50%	80.09%	62.74%	41.40%	28.90%	20.54%	13.15%	7.66%	3.72%	CONTROL
% DIFF	-0.97%	3.52%	2.28%	1.28%	1.90%	2.00%	1.61%	1.91%	4.18%	
NCAT-3	99.16%	81.68%	64.78%	43.70%	31.90%	23.41%	14.84%	7.91%	3.14%	EXP
non-NCAT-6	99.24%	78.83%	63.42%	43.15%	31.60%	23.12%	14.77%	8.27%	3.63%	CONTROL
% DIFF	-0.07%	2.85%	1.36%	0.55%	0.30%	0.28%	0.06%	-0.35%	-0.49%	
NCAT-4	100.00%	80.47%	64.06%	42.26%	29.88%	21.37%	13.44%	7.38%	3.15%	EXP
non-NCAT-7	98.59%	82.73%	66.32%	42.41%	28.37%	19.66%	12.50%	7.28%	3.55%	CONTROL
% DIFF	1.41%	-2.26%	-2.27%	-0.15%	1.50%	1.70%	0.94%	0.10%	-0.40%	

PAGOSA TROUT LAKES **15 POSSIBLE COMBINATIONS**

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-4	100.00%	76.34%	52.40%	35.85%	25.35%	18.28%	12.53%	8.36%	5.83%	EXP
Non NCAT-7	99.79%	79.37%	56.00%	38.61%	27.73%	20.00%	13.62%	8.91%	6.34%	CONTROL
% DIFF	0.21%	-3.04%	-3.60%	-2.76%	-2.38%	-1.71%	-1.09%	-0.55%	-0.51%	
NCAT-5	100.00%	74.63%	50.46%	37.59%	27.07%	19.71%	13.81%	9.44%	6.61%	EXP
Non NCAT-8	100.00%	75.03%	50.12%	34.20%	24.37%	17.49%	11.94%	7.99%	5.64%	CONTROL
% DIFF	0.00%	-0.40%	0.35%	3.39%	2.70%	2.22%	1.87%	1.45%	0.97%	

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200	
NCAT-4	100.00%	76.34%	52.40%	35.85%	25.35%	18.28%	12.53%	8.36%	5.83%	EXP
Non NCAT-8	100.00%	75.03%	50.12%	34.20%	24.37%	17.49%	11.94%	7.99%	5.64%	CONTROL
% DIFF	0.00%	1.31%	2.28%	1.65%	0.99%	0.79%	0.59%	0.37%	0.19%	
NCAT-5	100.00%	74.63%	50.46%	37.59%	27.07%	19.71%	13.81%	9.44%	6.61%	EXP
Non NCAT-7	99.79%	79.37%	56.00%	38.61%	27.73%	20.00%	13.62%	8.91%	6.34%	CONTROL
% DIFF	0.21%	-4.75%	-5.54%	-1.02%	-0.66%	-0.29%	0.20%	0.53%	0.27%	
NCAT-6	100.00%	75.65%	51.00%	36.76%	25.63%	18.29%	12.65%	8.59%	5.94%	EXP
Non NCAT-7	99.79%	79.37%	56.00%	38.61%	27.73%	20.00%	13.62%	8.91%	6.34%	CONTROL
% DIFF	0.21%	-3.73%	-5.00%	-1.85%	-2.10%	-1.71%	-0.96%	-0.33%	-0.40%	
NCAT-6	100.00%	75.65%	51.00%	36.76%	25.63%	18.29%	12.65%	8.59%	5.94%	EXP
Non NCAT-8	100.00%	75.03%	50.12%	34.20%	24.37%	17.49%	11.94%	7.99%	5.64%	CONTROL
% DIFF	0.00%	0.62%	0.88%	2.56%	1.26%	0.80%	0.72%	0.60%	0.30%	

FRANCISCOTTI
CONTROL ONLY

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
% DIFF.	-0.41%	-2.63%	-2.08%	-3.18%	-3.93%	-3.64%	-2.66%	-1.71%	-1.02%
% DIFF.	-0.41%	-1.97%	-1.82%	-1.13%	-0.69%	-0.62%	-0.62%	-0.59%	-0.47%
% DIFF.	-0.13%	-3.50%	-5.02%	-5.23%	-4.51%	-3.38%	-2.21%	-1.42%	-0.91%
% DIFF.	-0.00%	0.66%	0.26%	2.05%	3.24%	3.02%	2.04%	1.13%	0.55%
% DIFF.	0.28%	-0.87%	-2.93%	-2.05%	-0.58%	0.27%	0.45%	0.30%	0.11%
% DIFF.	0.28%	-1.53%	-3.19%	-4.10%	-3.81%	-2.76%	-1.59%	-0.83%	-0.44%
MEAN	-0.07%	-1.64%	-2.46%	-2.27%	-1.71%	-1.18%	-0.77%	-0.52%	-0.36%
STD. DEV.	0.31%	1.45%	1.75%	2.57%	2.96%	2.59%	1.78%	1.07%	0.60%

DATA USED TO GENERATE FIG. 7

FRANCISCOTTI

A FRANCISCOTTI STD. DEV. (1S)	B AASHTO T 27 STD. DEV. (1S)	DIFF. A-B
0.31%		
1.45%	1.38%	0.07%
1.75%	0.64%	1.11%
2.57%	0.60%	1.97%
2.96%	0.43%	2.53%
2.59%	0.43%	2.16%
1.78%	0.43%	1.35%
1.07%	0.43%	0.64%
0.60%	0.14%	0.46%

RALSTON

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
% DIFF.	0.12%	-1.68%	-1.85%	-2.79%	-2.71%	-2.07%	-1.08%	-0.50%	-0.16%
% DIFF.	-0.00%	-1.75%	-1.86%	0.21%	0.36%	0.28%	0.13%	-0.05%	-0.21%
% DIFF.	0.39%	-3.83%	-2.52%	-3.20%	-3.26%	-2.48%	-1.26%	-0.68%	-0.40%
% DIFF.	-0.12%	-0.08%	-0.01%	3.00%	3.07%	2.35%	1.22%	0.45%	-0.05%
% DIFF.	0.27%	-2.16%	-0.67%	-0.42%	-0.56%	-0.41%	-0.18%	-0.18%	-0.24%
% DIFF.	0.39%	-2.08%	-0.66%	-3.41%	-3.63%	-2.76%	-1.40%	-0.63%	-0.19%
MEAN	0.17%	-1.93%	-1.26%	-1.10%	-1.12%	-0.85%	-0.43%	-0.27%	-0.21%
STD. DEV.	0.21%	1.20%	0.96%	2.51%	2.59%	1.98%	1.01%	0.43%	0.12%

RALSTON

A RALSTON STD. DEV. (1S)	B AASHTO T 27 STD. DEV. (1S)	DIFF. A-B
0.21%		
1.20%	0.95%	0.25%
0.96%	0.60%	0.36%
2.51%	0.64%	1.87%
2.59%	0.60%	1.99%
1.98%	0.43%	1.55%
1.01%	0.43%	0.58%
0.43%	0.43%	-0.00%
0.12%	0.14%	-0.02%

VALCO/ROCKY MOUNTAIN/CAS PIT

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
% DIFF.	0.49%	1.77%	2.57%	2.02%	2.34%	2.28%	1.20%	0.51%	0.24%
% DIFF.	0.24%	0.26%	0.12%	-0.54%	-1.25%	-1.19%	-0.54%	-0.29%	-0.25%
% DIFF.	-0.00%	2.86%	1.55%	0.95%	0.54%	0.78%	0.62%	0.38%	0.22%
% DIFF.	-0.25%	-1.51%	-2.45%	-2.56%	-3.59%	-3.47%	-1.74%	-0.80%	-0.49%
% DIFF.	-0.49%	1.09%	-1.02%	-1.07%	-1.80%	-1.50%	-0.58%	-0.13%	-0.02%
% DIFF.	-0.24%	2.60%	1.43%	1.49%	1.79%	1.97%	1.16%	0.68%	0.47%
MEAN	-0.04%	1.18%	0.37%	0.05%	-0.33%	-0.19%	0.02%	0.06%	0.03%
STD. DEV.	0.36%	1.63%	1.86%	1.74%	2.28%	2.24%	1.17%	0.56%	0.35%

VALCO/ROCKY MOUNTAIN/CAS P

A VALCO/ROCKY MOUNTAIN/CAS PIT STD. DEV. (1S)	B AASHTO T 27 STD. DEV. (1S)	DIFF.
0.36%		
1.63%	1.38%	0.25%
1.86%	0.60%	1.26%
1.74%	0.60%	1.14%
2.28%	0.60%	1.68%
2.24%	0.43%	1.81%
1.17%	0.60%	0.57%
0.56%	0.43%	0.13%
0.35%	0.14%	0.21%

IRWIN/ WINDSOR / STUTE

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
% DIFF.	0.30%	-0.98%	-0.30%	-1.14%	-0.21%	0.12%	-0.02%	-0.28%	-0.50%
% DIFF.	0.00%	4.79%	3.32%	0.84%	1.41%	1.97%	1.55%	0.83%	0.32%
% DIFF.	0.60%	0.29%	-0.89%	-1.82%	-1.72%	-1.36%	-0.82%	-0.53%	-0.36%
% DIFF.	-0.30%	5.77%	3.62%	1.98%	1.61%	1.85%	1.57%	1.11%	0.81%
% DIFF.	0.30%	1.27%	-0.59%	-0.68%	-1.51%	-1.48%	-0.81%	-0.25%	0.14%
% DIFF.	0.60%	-4.50%	-4.21%	-2.66%	-3.12%	-3.33%	-2.38%	-1.36%	-0.67%
MEAN	0.25%	1.11%	0.16%	-0.58%	-0.59%	-0.37%	-0.15%	-0.08%	-0.04%
STD. DEV.	0.35%	3.79%	2.93%	1.72%	1.87%	2.08%	1.53%	0.91%	0.57%

MONK PIT

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
% DIFF.	0.27%	1.26%	-0.68%	-1.75%	-2.70%	-2.58%	-1.62%	-0.60%	0.09%
% DIFF.	0.91%	-2.64%	-3.58%	-1.01%	0.52%	0.88%	0.65%	0.38%	0.17%
% DIFF.	0.01%	0.52%	-0.80%	-1.41%	-1.58%	-1.27%	-0.58%	0.01%	0.49%
% DIFF.	0.65%	-3.90%	-2.90%	0.74%	3.22%	3.46%	2.27%	0.99%	0.08%
% DIFF.	-0.26%	-0.75%	-0.12%	0.34%	1.12%	1.31%	1.04%	0.61%	0.40%
% DIFF.	-0.91%	3.15%	2.78%	-0.40%	-2.10%	-2.15%	-1.23%	-0.38%	0.32%
MEAN	0.11%	-0.39%	-0.88%	-0.58%	-0.25%	-0.06%	0.09%	0.17%	0.26%
STD. DEV.	0.65%	2.59%	2.26%	0.98%	2.27%	2.34%	1.49%	0.60%	0.17%

IRWIN/ WINDSOR / STUTE

A	B	DIFF.
IRWIN/ WINDSOR / STUTE		
STD. DEV. (1S)	AASHTO T 27	
0.35%	STD. DEV. (1S)	
3.79%	0.95%	2.84%
2.93%	0.64%	2.29%
1.72%	0.60%	1.12%
1.87%	0.60%	1.27%
2.08%	0.43%	1.65%
1.53%	0.43%	1.10%
0.91%	0.43%	0.48%
0.57%	0.43%	0.14%

MONK PIT

A	B	DIFF.
MONK PIT		
STD. DEV. (1S)	AASHTO T 27	
0.65%	STD. DEV. (1S)	
2.59%	0.95%	1.64%
2.26%	0.60%	1.66%
0.98%	0.64%	0.34%
2.27%	0.60%	1.67%
2.34%	0.43%	1.91%
1.49%	0.43%	1.06%
0.60%	0.43%	0.17%
0.17%	0.43%	-0.26%

FRANCISCOTTI
CONTROL ONLY

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
% DIFF.	-0.41%	-2.63%	-2.08%	-3.18%	-3.93%	-3.64%	-2.66%	-1.71%	-1.02%
% DIFF.	-0.41%	-1.97%	-1.82%	-1.13%	-0.69%	-0.62%	-0.62%	-0.59%	-0.47%
% DIFF.	-0.13%	-3.50%	-5.02%	-5.23%	-4.51%	-3.38%	-2.21%	-1.42%	-0.91%
% DIFF.	-0.00%	0.66%	0.26%	2.05%	3.24%	3.02%	2.04%	1.13%	0.55%
% DIFF.	0.28%	-0.87%	-2.93%	-2.05%	-0.58%	0.27%	0.45%	0.30%	0.11%
% DIFF.	0.28%	-1.53%	-3.19%	-4.10%	-3.81%	-2.76%	-1.59%	-0.83%	-0.44%
MEAN	-0.07%	-1.64%	-2.46%	-2.27%	-1.71%	-1.18%	-0.77%	-0.52%	-0.36%
STD. DEV.	0.31%	1.45%	1.75%	2.57%	2.96%	2.59%	1.78%	1.07%	0.60%

RALSTON

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
% DIFF.	0.12%	-1.68%	-1.85%	-2.79%	-2.71%	-2.07%	-1.08%	-0.50%	-0.16%
% DIFF.	-0.00%	-1.75%	-1.86%	0.21%	0.36%	0.28%	0.13%	-0.05%	-0.21%
% DIFF.	0.39%	-3.83%	-2.52%	-3.20%	-3.26%	-2.48%	-1.26%	-0.68%	-0.40%
% DIFF.	-0.12%	-0.08%	-0.01%	3.00%	3.07%	2.35%	1.22%	0.45%	-0.05%
% DIFF.	0.27%	-2.16%	-0.67%	-0.42%	-0.56%	-0.41%	-0.18%	-0.18%	-0.24%
% DIFF.	0.39%	-2.08%	-0.66%	-3.41%	-3.63%	-2.76%	-1.40%	-0.63%	-0.19%
MEAN	0.17%	-1.93%	-1.26%	-1.10%	-1.12%	-0.85%	-0.43%	-0.27%	-0.21%
STD. DEV.	0.21%	1.20%	0.96%	2.51%	2.59%	1.98%	1.01%	0.43%	0.12%

VALCO/ROCKY MOUNTAIN/CAS PIT

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
% DIFF.	0.49%	1.77%	2.57%	2.02%	2.34%	2.28%	1.20%	0.51%	0.24%
% DIFF.	0.24%	0.26%	0.12%	-0.54%	-1.25%	-1.19%	-0.54%	-0.29%	-0.25%
% DIFF.	-0.00%	2.86%	1.55%	0.95%	0.54%	0.78%	0.62%	0.38%	0.22%
% DIFF.	-0.25%	-1.51%	-2.45%	-2.56%	-3.59%	-3.47%	-1.74%	-0.80%	-0.49%
% DIFF.	-0.49%	1.09%	-1.02%	-1.07%	-1.80%	-1.50%	-0.58%	-0.13%	-0.02%
% DIFF.	-0.24%	2.60%	1.43%	1.49%	1.79%	1.97%	1.16%	0.68%	0.47%
MEAN	-0.04%	1.18%	0.37%	0.05%	-0.33%	-0.19%	0.02%	0.06%	0.03%
STD. DEV.	0.36%	1.63%	1.86%	1.74%	2.28%	2.24%	1.17%	0.56%	0.35%

IRWIN/ WINDSOR / STUTE

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
% DIFF.	0.30%	-0.98%	-0.30%	-1.14%	-0.21%	0.12%	-0.02%	-0.28%	-0.50%
% DIFF.	0.00%	4.79%	3.32%	0.84%	1.41%	1.97%	1.55%	0.83%	0.32%
% DIFF.	0.60%	0.29%	-0.89%	-1.82%	-1.72%	-1.36%	-0.82%	-0.53%	-0.36%
% DIFF.	-0.30%	5.77%	3.62%	1.98%	1.61%	1.85%	1.57%	1.11%	0.81%
% DIFF.	0.30%	1.27%	-0.59%	-0.68%	-1.51%	-1.48%	-0.81%	-0.25%	0.14%
% DIFF.	0.60%	-4.50%	-4.21%	-2.66%	-3.12%	-3.33%	-2.38%	-1.36%	-0.67%
MEAN	0.25%	1.11%	0.16%	-0.58%	-0.59%	-0.37%	-0.15%	-0.08%	-0.04%
STD. DEV.	0.35%	3.79%	2.93%	1.72%	1.87%	2.08%	1.53%	0.91%	0.57%

MONK PIT

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
% DIFF.	0.27%	1.26%	-0.68%	-1.75%	-2.70%	-2.58%	-1.62%	-0.60%	0.09%
% DIFF.	0.91%	-2.64%	-3.58%	-1.01%	0.52%	0.88%	0.65%	0.38%	0.17%
% DIFF.	0.01%	0.52%	-0.80%	-1.41%	-1.58%	-1.27%	-0.58%	0.01%	0.49%
% DIFF.	0.65%	-3.90%	-2.90%	0.74%	3.22%	3.46%	2.27%	0.99%	0.08%
% DIFF.	-0.26%	-0.75%	-0.12%	0.34%	1.12%	1.31%	1.04%	0.61%	0.40%
% DIFF.	-0.91%	3.15%	2.78%	-0.40%	-2.10%	-2.15%	-1.23%	-0.38%	0.32%
MEAN	0.11%	-0.39%	-0.88%	-0.58%	-0.25%	-0.06%	0.09%	0.17%	0.26%
STD. DEV.	0.65%	2.59%	2.26%	0.98%	2.27%	2.34%	1.49%	0.60%	0.17%

PAGOSA TROUT LAKES

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
% DIFF.	-0.06%	-3.49%	-8.30%	-8.01%	-6.85%	-5.16%	-3.43%	-2.07%	-1.30%
% DIFF.	-0.33%	-7.11%	-8.05%	-6.60%	-5.47%	-4.24%	-3.02%	-1.94%	-1.60%
% DIFF.	-0.26%	-1.53%	-3.66%	-0.94%	-1.62%	-1.40%	-0.85%	-0.42%	-0.31%
% DIFF.	-0.05%	-5.88%	-9.55%	-5.35%	-4.98%	-3.91%	-2.53%	-1.34%	-1.01%
% DIFF.	0.01%	-2.39%	-1.25%	2.66%	1.87%	1.25%	0.90%	0.73%	0.29%
% DIFF.	-0.20%	1.96%	4.63%	7.07%	5.23%	3.76%	2.58%	1.65%	0.99%
% DIFF.	-0.54%	-2.76%	-2.17%	-2.19%	-2.10%	-1.74%	-1.34%	-1.02%	-0.90%
% DIFF.	-0.21%	4.34%	5.88%	4.41%	3.36%	2.51%	1.68%	0.92%	0.70%
% DIFF.	0.34%	4.72%	6.81%	9.26%	7.33%	5.49%	3.92%	2.67%	1.89%
% DIFF.	0.28%	1.23%	-1.49%	1.25%	0.48%	0.33%	0.50%	0.60%	0.59%
MEAN	-0.10%	-1.09%	-1.71%	0.16%	-0.27%	-0.31%	-0.16%	-0.02%	-0.07%
STD. DEV.	0.27%	4.05%	5.96%	5.83%	4.76%	3.59%	2.48%	1.59%	1.14%

COMBINATIONS: [redacted]

Where n = sample set, r= paired

6 COMBINATIONS PER AGGREGATE SOURCE

FRANCISCOTTI

CONTROL SPECIMENS

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
596X-5	99.59%	67.61%	42.44%	30.68%	22.43%	15.40%	9.78%	6.16%	3.78%
596X-6	100.00%	70.25%	44.52%	33.86%	26.36%	19.04%	12.45%	7.88%	4.80%
% DIFF.	-0.41%	-2.63%	-2.08%	-3.18%	-3.93%	-3.64%	-2.66%	-1.71%	-1.02%
596X-5	99.59%	67.61%	42.44%	30.68%	22.43%	15.40%	9.78%	6.16%	3.78%
596X-7	100.00%	69.59%	44.26%	31.81%	23.13%	16.02%	10.40%	6.75%	4.25%
% DIFF.	-0.41%	-1.97%	-1.82%	-1.13%	-0.69%	-0.62%	-0.62%	-0.59%	-0.47%
596X-5	99.59%	67.61%	42.44%	30.68%	22.43%	15.40%	9.78%	6.16%	3.78%
596X-8	99.72%	71.11%	47.45%	35.91%	26.94%	18.78%	12.00%	7.58%	4.69%
% DIFF.	-0.13%	-3.50%	-5.02%	-5.23%	-4.51%	-3.38%	-2.21%	-1.42%	-0.91%
596X-6	100.00%	70.25%	44.52%	33.86%	26.36%	19.04%	12.45%	7.88%	4.80%
596X-7	100.00%	69.59%	44.26%	31.81%	23.13%	16.02%	10.40%	6.75%	4.25%
% DIFF.	-0.00%	0.66%	0.26%	2.05%	3.24%	3.02%	2.04%	1.13%	0.55%
596X-6	100.00%	70.25%	44.52%	33.86%	26.36%	19.04%	12.45%	7.88%	4.80%
596X-8	99.72%	71.11%	47.45%	35.91%	26.94%	18.78%	12.00%	7.58%	4.69%
% DIFF.	0.28%	-0.87%	-2.93%	-2.05%	-0.58%	0.27%	0.45%	0.30%	0.11%
596X-7	100.00%	69.59%	44.26%	31.81%	23.13%	16.02%	10.40%	6.75%	4.25%
596X-8	99.72%	71.11%	47.45%	35.91%	26.94%	18.78%	12.00%	7.58%	4.69%
% DIFF.	0.28%	-1.53%	-3.19%	-4.10%	-3.81%	-2.76%	-1.59%	-0.83%	-0.44%

RALSTON

CONTROL

SIEVE SIZE	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
non-NCAT-5	99.08%	77.93%	64.19%	39.97%	25.14%	15.68%	8.22%	4.54%	2.43%
non-NCAT-6	98.96%	79.61%	66.04%	42.76%	27.84%	17.75%	9.30%	5.04%	2.59%
% DIFF.	0.12%	-1.68%	-1.85%	-2.79%	-2.71%	-2.07%	-1.08%	-0.50%	-0.16%
non-NCAT-5	99.08%	77.93%	64.19%	39.97%	25.14%	15.68%	8.22%	4.54%	2.43%
non-NCAT-7	99.08%	79.69%	66.05%	39.76%	24.77%	15.39%	8.08%	4.60%	2.63%
% DIFF.	-0.00%	-1.75%	-1.86%	0.21%	0.36%	0.28%	0.13%	-0.05%	-0.21%
non-NCAT-5	99.08%	77.93%	64.19%	39.97%	25.14%	15.68%	8.22%	4.54%	2.43%
non-NCAT-8	98.69%	81.77%	66.71%	43.18%	28.40%	18.15%	9.48%	5.22%	2.83%

% DIFF.	0.39%	-3.83%	-2.52%	-3.20%	-3.26%	-2.48%	-1.26%	-0.68%	-0.40%
non-NCAT-6	98.96%	79.61%	66.04%	42.76%	27.84%	17.75%	9.30%	5.04%	2.59%
non-NCAT-7	99.08%	79.69%	66.05%	39.76%	24.77%	15.39%	8.08%	4.60%	2.63%
% DIFF.	-0.12%	-0.08%	-0.01%	3.00%	3.07%	2.35%	1.22%	0.45%	-0.05%
non-NCAT-6	98.96%	79.61%	66.04%	42.76%	27.84%	17.75%	9.30%	5.04%	2.59%
non-NCAT-8	98.69%	81.77%	66.71%	43.18%	28.40%	18.15%	9.48%	5.22%	2.83%
% DIFF.	0.27%	-2.16%	-0.67%	-0.42%	-0.56%	-0.41%	-0.18%	-0.18%	-0.24%
non-NCAT-7	99.08%	79.69%	66.05%	39.76%	24.77%	15.39%	8.08%	4.60%	2.63%
non-NCAT-8	98.69%	81.77%	66.71%	43.18%	28.40%	18.15%	9.48%	5.22%	2.83%
% DIFF.	0.39%	-2.08%	-0.66%	-3.41%	-3.63%	-2.76%	-1.40%	-0.63%	-0.19%

VALCO/ROCKY MOUNTAIN/CAS PIT:

CONTROL

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
NON NCAT-5	100.00%	75.67%	61.68%	45.32%	35.54%	26.49%	12.05%	5.00%	2.78%
NON NCAT-6	99.51%	73.90%	59.11%	43.30%	33.20%	24.21%	10.84%	4.49%	2.54%
% DIFF.	0.49%	1.77%	2.57%	2.02%	2.34%	2.28%	1.20%	0.51%	0.24%
NON NCAT-5	100.00%	75.67%	61.68%	45.32%	35.54%	26.49%	12.05%	5.00%	2.78%
NON NCAT-7	99.76%	75.41%	61.56%	45.86%	36.79%	27.68%	12.58%	5.29%	3.03%
% DIFF.	0.24%	0.26%	0.12%	-0.54%	-1.25%	-1.19%	-0.54%	-0.29%	-0.25%
NON NCAT-5	100.00%	75.67%	61.68%	45.32%	35.54%	26.49%	12.05%	5.00%	2.78%
NON NCAT-8	100.00%	72.81%	60.13%	44.37%	35.00%	25.71%	11.43%	4.61%	2.56%
% DIFF.	-0.00%	2.86%	1.55%	0.95%	0.54%	0.78%	0.62%	0.38%	0.22%
NON NCAT-6	99.51%	73.90%	59.11%	43.30%	33.20%	24.21%	10.84%	4.49%	2.54%
NON NCAT-7	99.76%	75.41%	61.56%	45.86%	36.79%	27.68%	12.58%	5.29%	3.03%
% DIFF.	-0.25%	-1.51%	-2.45%	-2.56%	-3.59%	-3.47%	-1.74%	-0.80%	-0.49%
NON NCAT-6	99.51%	73.90%	59.11%	43.30%	33.20%	24.21%	10.84%	4.49%	2.54%
NON NCAT-8	100.00%	72.81%	60.13%	44.37%	35.00%	25.71%	11.43%	4.61%	2.56%
% DIFF.	-0.49%	1.09%	-1.02%	-1.07%	-1.80%	-1.50%	-0.58%	-0.13%	-0.02%
NON NCAT-7	99.76%	75.41%	61.56%	45.86%	36.79%	27.68%	12.58%	5.29%	3.03%
NON NCAT-8	100.00%	72.81%	60.13%	44.37%	35.00%	25.71%	11.43%	4.61%	2.56%
% DIFF.	-0.24%	2.60%	1.43%	1.49%	1.79%	1.97%	1.16%	0.68%	0.47%

Irwin Windsor/Stute Pit:

CONTROL

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
NON NCAT-5	100.00%	80.67%	59.97%	43.01%	31.60%	22.14%	13.88%	8.29%	4.99%
NON NCAT-6	99.70%	81.64%	60.27%	44.14%	31.81%	22.03%	13.90%	8.57%	5.49%
% DIFF.	0.30%	-0.98%	-0.30%	-1.14%	-0.21%	0.12%	-0.02%	-0.28%	-0.50%
NON NCAT-5	100.00%	80.67%	59.97%	43.01%	31.60%	22.14%	13.88%	8.29%	4.99%
NON NCAT-7	100.00%	75.87%	56.65%	42.17%	30.19%	20.18%	12.33%	7.46%	4.67%
% DIFF.	0.00%	4.79%	3.32%	0.84%	1.41%	1.97%	1.55%	0.83%	0.32%
NON NCAT-5	100.00%	80.67%	59.97%	43.01%	31.60%	22.14%	13.88%	8.29%	4.99%
NON NCAT-8	99.40%	80.37%	60.86%	44.82%	33.32%	23.51%	14.71%	8.82%	5.34%
% DIFF.	0.60%	0.29%	-0.89%	-1.82%	-1.72%	-1.36%	-0.82%	-0.53%	-0.36%
NON NCAT-6	99.70%	81.64%	60.27%	44.14%	31.81%	22.03%	13.90%	8.57%	5.49%
NON NCAT-7	100.00%	75.87%	56.65%	42.17%	30.19%	20.18%	12.33%	7.46%	4.67%
% DIFF.	-0.30%	5.77%	3.62%	1.98%	1.61%	1.85%	1.57%	1.11%	0.81%
NON NCAT-6	99.70%	81.64%	60.27%	44.14%	31.81%	22.03%	13.90%	8.57%	5.49%
NON NCAT-8	99.40%	80.37%	60.86%	44.82%	33.32%	23.51%	14.71%	8.82%	5.34%
% DIFF.	0.30%	1.27%	-0.59%	-0.68%	-1.51%	-1.48%	-0.81%	-0.25%	0.14%
NON NCAT-7	100.00%	75.87%	56.65%	42.17%	30.19%	20.18%	12.33%	7.46%	4.67%
NON NCAT-8	99.40%	80.37%	60.86%	44.82%	33.32%	23.51%	14.71%	8.82%	5.34%
% DIFF.	0.60%	-4.50%	-4.21%	-2.66%	-3.12%	-3.33%	-2.38%	-1.36%	-0.67%

MONK PIT:
CONTROL

SIEVE SIZE	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
NON NCAT-5	99.50%	80.09%	62.74%	41.40%	28.90%	20.54%	13.15%	7.66%	3.72%
NON NCAT-6	99.24%	78.83%	63.42%	43.15%	31.60%	23.12%	14.77%	8.27%	3.63%
% DIFF.	0.27%	1.26%	-0.68%	-1.75%	-2.70%	-2.58%	-1.62%	-0.60%	0.09%
NON NCAT-5	99.50%	80.09%	62.74%	41.40%	28.90%	20.54%	13.15%	7.66%	3.72%
NON NCAT-7	98.59%	82.73%	66.32%	42.41%	28.37%	19.66%	12.50%	7.28%	3.55%
% DIFF.	0.91%	-2.64%	-3.58%	-1.01%	0.52%	0.88%	0.65%	0.38%	0.17%
NON NCAT-5	99.50%	80.09%	62.74%	41.40%	28.90%	20.54%	13.15%	7.66%	3.72%
NON NCAT-8	99.50%	79.58%	63.54%	42.81%	30.48%	21.81%	13.73%	7.66%	3.23%
% DIFF.	0.01%	0.52%	-0.80%	-1.41%	-1.58%	-1.27%	-0.58%	0.01%	0.49%
NON NCAT-6	99.24%	78.83%	63.42%	43.15%	31.60%	23.12%	14.77%	8.27%	3.63%
NON NCAT-7	98.59%	82.73%	66.32%	42.41%	28.37%	19.66%	12.50%	7.28%	3.55%
% DIFF.	0.65%	-3.90%	-2.90%	0.74%	3.22%	3.46%	2.27%	0.99%	0.08%
NON NCAT-6	99.24%	78.83%	63.42%	43.15%	31.60%	23.12%	14.77%	8.27%	3.63%
NON NCAT-8	99.50%	79.58%	63.54%	42.81%	30.48%	21.81%	13.73%	7.66%	3.23%
% DIFF.	-0.26%	-0.75%	-0.12%	0.34%	1.12%	1.31%	1.04%	0.61%	0.40%
NON NCAT-7	98.59%	82.73%	66.32%	42.41%	28.37%	19.66%	12.50%	7.28%	3.55%

NON NCAT-8	99.50%	79.58%	63.54%	42.81%	30.48%	21.81%	13.73%	7.66%	3.23%
% DIFF.	-0.91%	3.15%	2.78%	-0.40%	-2.10%	-2.15%	-1.23%	-0.38%	0.32%

PAGOSA TROUT LAKES
CONTROL

	1/2	3/8	#4	#8	#16	#30	#50	#100	#200
Non NCAT-1	99.74%	73.50%	46.45%	33.26%	22.75%	16.09%	11.09%	7.57%	5.33%
Non NCAT-2	99.80%	76.99%	54.75%	41.27%	29.60%	21.25%	14.52%	9.64%	6.63%
% DIFF.	-0.06%	-3.49%	-8.30%	-8.01%	-6.85%	-5.16%	-3.43%	-2.07%	-1.30%
Non NCAT-3	99.46%	72.27%	47.95%	32.01%	22.27%	15.76%	10.59%	6.97%	4.74%
Non NCAT-7	99.79%	79.37%	56.00%	38.61%	27.73%	20.00%	13.62%	8.91%	6.34%
% DIFF.	-0.33%	-7.11%	-8.05%	-6.60%	-5.47%	-4.24%	-3.02%	-1.94%	-1.60%
Non NCAT-1	99.74%	73.50%	46.45%	33.26%	22.75%	16.09%	11.09%	7.57%	5.33%
Non NCAT-8	100.00%	75.03%	50.12%	34.20%	24.37%	17.49%	11.94%	7.99%	5.64%
% DIFF.	-0.26%	-1.53%	-3.66%	-0.94%	-1.62%	-1.40%	-0.85%	-0.42%	-0.31%
Non NCAT-1	99.74%	73.50%	46.45%	33.26%	22.75%	16.09%	11.09%	7.57%	5.33%
Non NCAT-7	99.79%	79.37%	56.00%	38.61%	27.73%	20.00%	13.62%	8.91%	6.34%
% DIFF.	-0.05%	-5.88%	-9.55%	-5.35%	-4.98%	-3.91%	-2.53%	-1.34%	-1.01%
Non NCAT-2	99.80%	76.99%	54.75%	41.27%	29.60%	21.25%	14.52%	9.64%	6.63%
Non NCAT-7	99.79%	79.37%	56.00%	38.61%	27.73%	20.00%	13.62%	8.91%	6.34%
% DIFF.	0.01%	-2.39%	-1.25%	2.66%	1.87%	1.25%	0.90%	0.73%	0.29%
Non NCAT-2	99.80%	76.99%	54.75%	41.27%	29.60%	21.25%	14.52%	9.64%	6.63%
Non NCAT-8	100.00%	75.03%	50.12%	34.20%	24.37%	17.49%	11.94%	7.99%	5.64%
% DIFF.	-0.20%	1.96%	4.63%	7.07%	5.23%	3.76%	2.58%	1.65%	0.99%
Non NCAT-3	99.46%	72.27%	47.95%	32.01%	22.27%	15.76%	10.59%	6.97%	4.74%
Non NCAT-8	100.00%	75.03%	50.12%	34.20%	24.37%	17.49%	11.94%	7.99%	5.64%
% DIFF.	-0.54%	-2.76%	-2.17%	-2.19%	-2.10%	-1.74%	-1.34%	-1.02%	-0.90%
Non NCAT-7	99.79%	79.37%	56.00%	38.61%	27.73%	20.00%	13.62%	8.91%	6.34%
Non NCAT-8	100.00%	75.03%	50.12%	34.20%	24.37%	17.49%	11.94%	7.99%	5.64%
% DIFF.	-0.21%	4.34%	5.88%	4.41%	3.36%	2.51%	1.68%	0.92%	0.70%
Non NCAT-2	99.80%	76.99%	54.75%	41.27%	29.60%	21.25%	14.52%	9.64%	6.63%
Non NCAT-3	99.46%	72.27%	47.95%	32.01%	22.27%	15.76%	10.59%	6.97%	4.74%
% DIFF.	0.34%	4.72%	6.81%	9.26%	7.33%	5.49%	3.92%	2.67%	1.89%
Non NCAT-1	99.74%	73.50%	46.45%	33.26%	22.75%	16.09%	11.09%	7.57%	5.33%
Non NCAT-3	99.46%	72.27%	47.95%	32.01%	22.27%	15.76%	10.59%	6.97%	4.74%
% DIFF.	0.28%	1.23%	-1.49%	1.25%	0.48%	0.33%	0.50%	0.60%	0.59%

FIGURE 8

DATA USED FOR GRAPH OF DIFF. BETWEEN FIG. 6 AND 7

FRANCISCOTTI

	DATA USED FOR FIG. 7	DATA USED FOR FIG. 6	
SIEVE SIZE	PRECISION (1S),%	PRECISION (1S),%	FIG. 7 - 6
1/2			
3/8	0.07	**0.13**	-0.06
#4	1.1	**1.29**	-0.19
#8	1.97	**1.52**	0.45
#16	2.53	**1.68**	0.85
#30	2.16	**0.77**	1.39
#50	1.35	**0.76**	0.59
#100	0.64	**0.30**	0.34
#200	0.46	**0.31**	0.15

RALSTON

SIEVE SIZE			
1/2			
3/8	0.25	**0.82**	-0.57
#4	0.36	**1.2**	-0.84
#8	1.87	**1.66**	0.21
#16	1.99	**1.52**	0.47
#30	1.55	**1.29**	0.26
#50	0.58	**0.58**	-0.00
#100	0	**0.11**	-0.11
#200	-0.2	**0.15**	-0.35

VALCO/ROCKY MOUNTAIN/CAS PIT

SIEVE SIZE			
1/2			
3/8	0.25	**0.97**	-0.72
#4	1.26	**1.69**	-0.43
#8	1.14	**1.46**	-0.32
#16	1.68	**1.44**	0.24
#30	1.81	**1.38**	0.43
#50	0.57	**0.28**	0.29
#100	0.13	**-0.05**	0.18
#200	0.21	**0.07**	0.14

FIGURE 8

DATA USED FOR GRAPH OF
DIFF. BETWEEN FIG. 6 AND 7

IRWIN/ WINDSOR / STUTE

SIEVE SIZE			
1/2			
3/8	2.84	1.68	1.16
#4	2.29	1.33	0.96
#8	1.12	1.1	0.02
#16	1.27	1.41	-0.14
#30	1.65	1.51	0.14
#50	1.1	0.92	0.18
#100	0.48	0.35	0.13
#200	0.14	0.02	0.12

MONK PIT

SIEVE SIZE			
1/2			
3/8	1.64	0.96	0.68
#4	1.66	1.13	0.53
#8	0.34	1.69	-1.35
#16	1.67	2.37	-0.70
#30	1.91	2.29	-0.38
#50	1.06	1.35	-0.29
#100	0.17	0.77	-0.60
#200	-0.26	1.7	-1.96

MEAN 0.02

1. Determination of Correction Factors Using Analysis Method Two

Determination of Correction Factors

DATA USED FOR GRAPH OF DIFF. BETWEEN FIG. 6 AND 7

FRANCISCOTTI

	DATA USED FOR FIG. 7	DATA USED FOR FIG. 6				
SIEVE SIZE	PRECISION (1S),%	PRECISION (1S),%	ABS VALUE FIG. 7 - 6	(1S) AASHTO LIMITS %	IS THE DIFF. BETWEEN FIG. 6 AND 5 WITHIN (1S) AASHTO LIMITS ?	CORRECTION FACTOR REQUIRED (%)
1/2						
3/8	0.07	0.13	0.06	1.38	Y	
#4	1.1	1.29	0.19	0.64	Y	
#8	1.97	1.52	0.45	0.6	Y	
#16	2.53	1.68	0.85	0.43	N	0.42
#30	2.16	0.77	1.39	0.43	N	0.96
#50	1.35	0.76	0.59	0.43	N	0.16
#100	0.64	0.30	0.34	0.43	Y	
#200	0.46	0.31	0.15	0.14	N	0.01

RALSTON

SIEVE SIZE						
1/2						
3/8	0.25	0.82	0.57	0.95	Y	
#4	0.36	1.2	0.84	0.6	N	0.24
#8	1.87	1.66	0.21	0.64	Y	
#16	1.99	1.52	0.47	0.6	Y	
#30	1.55	1.29	0.26	0.43	Y	
#50	0.58	0.58	0.00	0.43	Y	
#100	0	0.11	0.11	0.43	Y	
#200	-0.2	0.15	0.35	0.14	N	0.21

VALCO/ROCKY MOUNTAIN/CAS PIT

SIEVE SIZE					
1/2					
3/8	0.25	0.97	0.72	1.38	Y
#4	1.26	1.69	0.43	0.60	Y
#8	1.14	1.46	0.32	0.60	Y
#16	1.68	1.44	0.24	0.60	Y
#30	1.81	1.38	0.43	0.43	Y
#50	0.57	0.28	0.29	0.60	Y
#100	0.13	-0.05	0.18	0.43	Y
#200	0.21	0.07	0.14	0.14	Y

Determination of Correction Factors

DATA USED FOR GRAPH OF
DIFF. BETWEEN FIG. 6 AND 7

IRWIN/ WINDSOR / STUTE

SIEVE SIZE						
1/2						
3/8	2.84	1.68	1.16	0.95	N	0.21
#4	2.29	1.33	0.96	0.64	N	0.32
#8	1.12	1.1	0.02	0.60	Y	
#16	1.27	1.41	0.14	0.60	Y	
#30	1.65	1.51	0.14	0.43	Y	
#50	1.1	0.92	0.18	0.43	Y	
#100	0.48	0.35	0.13	0.43	Y	
#200	0.14	0.02	0.12	0.43	Y	

MONK PIT

SIEVE SIZE						
1/2						
3/8	1.64	0.96	0.68	0.95	Y	
#4	1.66	1.13	0.53	0.60	Y	
#8	0.34	1.69	1.35	0.64	N	0.71
#16	1.67	2.37	0.70	0.60	N	0.1
#30	1.91	2.29	0.38	0.43	Y	
#50	1.06	1.35	0.29	0.43	Y	
#100	0.17	0.77	0.60	0.43	N	0.17
#200	-0.26	1.7	1.96	0.43	N	1.53

MEAN 0.47

APPENDIX E

CPL-5120

Colorado Procedure
L 5120

Method of Test For

Determination of the Asphalt Binder Content of Bituminous Mixtures By the Ignition Method

1. Scope

1.1 This method of test determines the asphalt binder content of bituminous mixtures by heating the mixture until the asphalt binder fraction of the mix ignites and is burned away. The gradation of the remaining aggregate may then be determined using CP 31. The applicability of this procedure to mixtures containing recycled asphalt pavement (RAP) has not been determined.

1.2 This standard may involve hazardous materials, operations, and equipment. This standard does not purport to address all of the safety problems associated with its use. It is the responsibility of the user of this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

2. Referenced Documents

Colorado Procedures:

CP-30	Field Sampling Aggregates for use as Highway Material
CP-31	Sieve analysis, -200 Washed Gradation
CP-41	Sampling Fresh Bituminous Paving Mixtures
CP-55	Method for reducing samples of Hot Bituminous Pavements to Test size
CP-L 5105	Standard Practice for Preparation of Test Specimens of Bituminous Mixtures by Means of Gyratory Shear Compactor
CP-L 5115	Standard Method for Preparing and Determining the Density of Bituminous Mixture Test Specimens by Means of the SHRP Gyratory Compactor

3. Summary of Test Methods

3.1 A specimen of bituminous mixture is heated in an oven having a temperature of 538° C (1000° F) until the asphalt binder fraction ignites and is burned away. The asphalt binder content is calculated by dividing the weight loss of the specimen during ignition by the mass of the bituminous mixture before ignition. A correction factor is determined for each bituminous mixture and then applied to the measured asphalt binder content of field produced bituminous mixture.

4. Apparatus

4.1.1 *Forced-air ignition furnace, with internal balance,* capable of maintaining a temperature of 500° C (930° F) to 650° C (1200° F), having an internal balance thermally isolated from the furnace chamber and accurate at room temperature to 0.1 gram. The balance shall be capable of weighing a 3,500 gram specimen contained in a basket assembly while it is heated. The National Center for Asphalt Technology Asphalt Content Tester (NCAT oven), is an oven containing a temperature compensated internal scale which has been found to be suitable for determining asphalt binder contents. It is the only oven which currently has been evaluated for the purposes of this procedure.

4.1.2 *Forced-air ignition furnace, without internal balance,* capable of maintaining a temperature of 500° C (930° F) to 650° C (1200° F) may also be suitable. A testing procedure has not been developed or tested using this type of equipment. Potential users of this type of equipment will need to develop and use a test procedure which can be shown by statistical methods to provide adequate test result accuracy.

4.2 *Two tempered stainless steel 2.36 mm (No. 8) mesh perforated basket assemblies*, approximate dimensions (L x W x H) 26.7 x 26.7 x 5.1 cm with 5 cm support legs. The baskets shall be nested. The top basket shall be provided with No. 20 mesh screening on the legs to confine the aggregate.

4.3 *Stainless steel catch/drip pan* per basket assembly, approximate dimensions (L x W x H) of 28.0 x 28.0 x 2.6 cm.

4.4 *Oven* - A forced draft oven capable of maintaining a temperature of 121 ± 5°C.

4.5 *External balance*, at least 10 kg capacity, sensitive to 0.1 g.

4.6 *Safety equipment*: High temperature face shield, gloves, and a fire resistant long sleeve coat. In addition, a heat resistant surface capable of withstanding a temperature of 650° C and a protective cage capable of surrounding the basket assembly shall be provided.

4.7 *Miscellaneous equipment*: a pan having dimensions of approximately (L x W x H) 38 x 38 x 5 cm for transferring specimen after ignition, spatulas, bowls, and wire brushes.

5. Reducing Production Samples to Test Size

NOTE 1: The word *specimen* represents a test quantity of bituminous mixture. When the specimen's mass exceeds the capacity of test equipment, it may be divided into multiple units, tested, and the results recombined.

NOTE 2: The word *sample* represents a quantity of bituminous mixture gathered from a stockpile or roadway in accordance with CP-41.

5.1.1 If the bituminous mixture is not sufficiently soft to separate with a spatula or trowel, place it in a pan and warm it in a 121° C (250° F) oven until it can be so handled.

5.1.2 Sampling of HBP shall be done according to CP-30. Two separate, identical specimens shall be selected from each bituminous mixture production sample in accordance with CP-55. The two specimens shall not be combined at any time after they have been taken.

5.2 The specimens shall conform to the mass requirements shown in the appropriate column of Table 1 depending on whether or not an aggregate gradation is required.

6. Determination of Mix Correction Factors Using Laboratory Mixed Specimens

6.1 The results measured by this procedure may be affected by the types of aggregate and asphalt binder contained in the bituminous mixture. To ensure accuracy, a correction factor shall be established for each mix design.

6.2 At least three laboratory produced specimens conforming to the mass requirements of Table 1 (gradation not required) shall be prepared at the design asphalt binder content. Record the weights according to Section 6.2.1

TABLE 1: Size of Specimen

Nominal Maximum Aggregate size, mm	Sieve size	Minimum mass of specimen (g). **(If a gradation is required)**	Minimum mass of specimen (g). **(If a gradation is not required)**
4.75	(no. 4)	1200	1100
9.5	3/8 in.	1200	1100
12.5	½ in.	1700	1100
19.0	3/4 in.	2200	1500
25.0	1 in.	3000	2200
37.5	1 ½ in.	5500	3300

Some specimen weights specified here may exceed the capacity of the temperature compensated internal oven scale. These specimens may be divided, the separate parts tested and the results recombined.

and follow the instructions for the Preparation of Laboratory Produced Specimens contained within CP-L 5105 or CP-L 5115.

6.2.1 Before mixing the specimens, record the weights of both the oven-dry aggregate and the asphalt binder contained in each specimen to the nearest 0.1 gram.

6.3 Follow Sections 7.1 through 7.14 to obtain an uncorrected asphalt binder content determination for each of the three specimens.

6.4 Determine the difference, or correction factor, between the actual asphalt binder content and the uncorrected asphalt binder content measured using both the temperature compensated internal oven scale and the external scale for each of the three specimens as specified in Sections 6.4.1 to 6.5.

6.4.1 Determine the actual asphalt binder content for each of the specimens (Section 9.1).

6.4.2 Following Section 7, determine the measured asphalt binder content for each of the specimens using both the external scale (Section 9.2.1) and the temperature compensated internal oven scale (Section 9.2.2).

6.4.3 Determine the correction factors for each of the specimens (Section 9.3).

NOTE 3: If the difference between the lowest and highest correction factor is greater than 0.30 percent, then mix and burn another specimen or specimens until the correction factors determined using three specimens of the same bituminous mixture are within 0.30 percent of each other.

6.5 Calculate the average correction factors for both the external scale and the temperature compensated internal oven scale.

7. Test Procedure

7.1 All production specimens shall be dried as specified in Section 7.1.1. Laboratory mixed specimens which have been exposed to moisture or have been stored at less than 100° C (212° F) for greater than 48 hours shall be dried according to Section 7.1.1. Laboratory mixed specimens which have not been exposed to moisture and which have not been stored at less than 100° C (212° F) for greater than 48 hours shall be heated according to Section 7.1.2.

7.1.1 Specimens as specified in Section 7.1 shall be dried in a 121° C (250° F) oven for 10 ± 5 hours.

7.1.2 Initially dry specimens (as specified in Section 7.1) shall be heated by placing them into a 121° C (250° F) oven for 3 ± 1 hours.

7.2 Set the test temperature to 538° C (1000° F) by pressing the "TEMP" key on the NCAT oven, entering "538" and pressing the "ENTER" key. Allow a minimum of 2-1/2 hours for the NCAT oven to reach test temperature. Record the temperature set point prior to the initiation of the test.

7.2.1 Enter a correction factor of zero into the NCAT oven keyboard for all mixes by pressing the "CALIB" key, entering "0" and pressing the "ENTER" key. Press the "CALIB. FACTOR" key on the NCAT oven panel to verify that the correction factor is zero. The correction factor is labeled as the "calib. factor" on the NCAT oven tape printout.

7.3 Weigh the empty basket assembly, consisting of the two baskets and drip pan with wire guards in place, on an external scale and record the weight.

7.4 Remove the top basket of the assembly and evenly distribute approximately ½ of the testing specimen in the bottom basket. Spread the bituminous mixture to a uniform depth in the tray, leaving a gap of approximately 10 mm between the specimen and the edge of the basket. Finer material should be kept near the center of the basket tray.

7.5 Place the top tray onto the bottom tray and load the remaining specimen into the top tray. Place the top cover over the basket and fasten the restraining wire into the slots on the drip tray of the basket assembly.

7.6 Weigh the loaded basket assembly on an external scale and record the weight. Determine the net weight of the mix contained in the basket assembly.

7.7 Press the "WEIGHT" button on the NCAT oven keyboard and enter the weight of the bituminous mixture being tested, rounded to the nearest whole gram, into the temperature compensated internal scale oven and then press the "ENTER" button.

7.8 Tare the temperature compensated scale oven digital readout by pressing a wire into the hole at the right hand end of the display panel.

NOTE 4: Wear protective clothing (Section 4.6) whenever working near the NCAT oven while the oven door is open.

7.9 Open the chamber door. Lift the loaded basket assembly using the locking handle tool and place it into the NCAT oven. Close the oven door and allow 2 to 3 seconds for the oven scale to stabilize. Compare the external scale reading of the loaded basket assembly weight to the NCAT oven scale reading. Verify that the NCAT oven scale's weight reading equals the weight determined in Section 7.6 within ± 5 grams. Differences greater than 5 grams or failure of the oven scale to stabilize may indicate that the basket assembly is contacting the interior walls of the oven.

7.10 Initiate the test within 10 seconds of closing the oven door by pressing the "START/STOP" button. This will lock the oven door. After approximately 20 seconds the temperature compensated internal oven scale will zero itself and the digital timer will start running.

NOTE 5: Do not attempt to open the oven door while Error 11 is flashing since the oven's contents may ignite violently. Turn off the oven and allow the contents to cool before opening the oven door.

7.11 Once the specimen weight is stable for a period of 2-3 consecutive minutes the light indicating a stable weight will illuminate without blinking and an audible beep will sound. Press the "START/STOP" button to stop the test and unlock the oven door. Use the locking handle to remove the basket assembly within 5 minutes of the illumination of the light signaling the end of the test.

7.12 Place the hot basket assembly on top of the ceramic cooling plate and place the safety cage over it.

7.13 Remove the printed tape from the temperature compensated internal oven scale and record the weight loss in percent, the temperature compensation, and the calculated asphalt binder content for the specimen. Record the specimen number and retain the printout as a record of the test.

7.14 Allow a minimum of 35 minutes for the basket assembly to cool to room temperature or until it is warm to the touch. Weigh the basket assembly containing the residual aggregate on an external scale and record the weight.

7.15 Determine the uncorrected asphalt binder content for the external scale and the temperature compensated internal oven scale (Sections 9.2.1 and 9.2.2).

7.16 Determine the corrected asphalt binder content for the external scale and the temperature compensated internal oven scale (Section 9.4)

8. Gradation (Optional)

8.1 Empty the residual aggregate from the baskets into a flat pan. Use a small wire brush to ensure that any residual fines are removed from the baskets. Weigh the residual aggregate on an external scale and record the weight.

8.2 Perform a gradation analysis in accordance with CP 31.

8.3 CDOT has verified that the gradation results are the same with and without exposure to heat for aggregates from a wide variety of sources. However, there may be aggregates which degrade when exposed to the heat required to burn asphalt binder. If aggregate degradation is suspected, or if the test results will be used for project acceptance, Sections 8.3.1 to 8.3.6 may be used to verify whether aggregates have a tendency to degrade.

8.3.1 Obtain a sample of the final aggregate blend in question from a conveyor belt discharge or a stopped conveyor belt according to CP 30.

Method Subject to Revision.

8.3.2 Using a sample splitter, split a sample weighing at least 8 times the sample size specified in Table 1 (gradation required) into 8 specimens having approximately equal mass. Set 4 specimens aside.

8.3.3 Mix 4 of the aggregate specimens with asphalt cement to yield specimens having an asphalt binder content within 0.5 percent of the mix in question.

8.3.4 Test the 4 mixed specimens as specified in Section 7.

8.3.5 Using CP-31, determine the gradation of the 4 specimens which were mixed with asphalt binder and burned. Determine the gradation of the 4 specimens which were set aside in Section 8.3.2.

8.3.6 Calculate the average percent passing each sieve size for the 2 sets of 4 specimens. Compare the average gradation at each sieve size for the two sets of specimens. If the gradation of the aggregate exposed to the heat applied in Section 8.3.4 is more than 3 percent finer than the untreated aggregate on any of the sieves, the aggregate may be sensitive to heat degradation. If the average gradation is within 3 percent on all screens, the aggregate is not sensitive to heat degradation.

8.3.7 If an aggregate has been found to be sensitive to heat degradation in Section 8.3.6, apply a correction factor to the percent passing each screen to account for the degradation caused by the NCAT oven.

9. Calculations

9.1 The actual asphalt binder content of a laboratory mixed specimen is determined as follows:

$$P_{b(actual)} = \frac{W_b}{W_s + W_b} \times 100$$

where,

$P_{b(actual)}$ = percent of asphalt binder in specimen
W_s = weight of aggregate in specimen
W_b = weight of asphalt binder in specimen

9.2.1 The uncorrected asphalt binder content of a specimen is determined using an external scale as follows:

$$P_{b(uncorr)} = \frac{(W_{m(initial)} + W_{basket}) - (W_{m(final)} + W_{basket})}{(W_{m(initial)} + W_{basket})} \times 100$$

where,

$P_{b(uncorr)}$ = uncorrected asphalt binder content, in percent, determined by the mass loss measured on an external scale.
$W_{m(initial)}$ = Weight of the bituminous mixture specimen before using the temperature compensated internal oven scale measured at 121° C (250° F).
$W_{m(final)}$ = Weight of the bituminous mixture specimen after using the temperature compensated internal oven scale measured at room temperature.
W_{basket} = Weight of the empty basket assembly at room temperature.

9.2.2 The uncorrected asphalt binder content of a specimen is automatically calculated by the temperature compensated internal oven's scale software using the bituminous mixture weight input in Section 7.7. At the end of each test, the uncorrected asphalt binder content is printed on a paper tape.

9.3 The mix correction factor is determined for asphalt binder contents determined using each method of measurement (both the external scale and the temperature compensated internal oven scale) as follows:

$$C_f = P_{b(actual)} - P_{b(measured)}$$

where,

C_f = asphalt binder correction factor determined for a specific method of measurement e.g. using the external or the temperature compensated internal oven scales.

$P_{b(measured)}$ = uncorrected asphalt binder content of a specimen as determined in Sections 9.2.1 or 9.2.2.

9.4 The corrected asphalt binder content for field produced specimens using both the external scale and the temperature compensated internal oven scale is determined as follows:

$$P_{b(corr)} = P_{b(uncorr)} + C_f$$

where,

$P_{b(corr)}$ = asphalt binder content of field produced specimens corrected for the aggregate and asphalt binder sources.

10. Report

10.1 Report the corrected asphalt binder contents determined using the external scale. Results from the temperature compensated internal oven scale should be reported for information only.

CDOT Research Report Publication List

91-1 Industrial Snow Fence vs. Wooden Fences
91-2 Rut Resistant Composite Pavement Design (Final Report)
91-3 Reflective Sheeting (Final Report)
91-4 Review of Field Tests and Development of Dynamic Analysis Program of CDOH Flexpost Fence
91-5 Geotextile Walls for Rockfall Control (canceled)
91-6 Fly Ash in Structural Concrete
91-7 Polyethylene Pipes for Use as Highway Culverts
91-8 Ice Detection System Evaluation
91-9 Evaluation of Swareflex Wildlife Warning Reflectors
91-10 analysis and Design of Geotextile Reinforced Earth Walls, Vol III Parametric Study and Preliminary Design Method

92-1 Colorado Department of Transportation Asphalt Pavement White Paper
92-2 Expansive Soil Treatment Methods in Colorado
92-3 Gilsonite - An Asphalt Modifier
92-4 Avalanche Characteristics and Structure Response - East Riverside Avalanche Shed, Highway 550, Ouray County Colorado
92-5 Special Polymer Modified Asphalt Cement - Interim report
92-6 A User Experience with Hydrain
92-7 Chloride Content Program for the Evaluation of Reinforced Concrete Bridge Decks
92-8 Evaluation of Unbonded Concrete Overlay
92-9 Fiber Pave, Polypropylene Fiber
92-10 Description of the Demonstration of European Testing Equipment for Hot Mix Asphalt Pavement
92-11 Comparison of Results Obtained From the French Rutting Tester With Pavements of Known Field Performance
92-12 Investigation of the Rutting Performance of Pavements in Colorado
92-13 Factors That Affect the Voids in the Mineral Aggregate In Hot Mix Asphalt
92-14 Comparison of Colorado Components Hot Mix Asphalt Materials With Some European Specifications
92-15 Investigation of Premature Distress in Asphalt Overlays on I 70 in Colorado

93-1 Dense Graded Concrete
93-2 Research 92- Reality and Vision, Today and Tomorrow (Status Report)
93-3 Investigation of the Modified Lottman Test to Predict the Stripping Performance of Pavements in Colorado
93-4 Lottman Repeatability\
93-5 Expert System for Retaining Wall System Phase I
93-6 Crack Reduction Pavement Reinforcement Glasgrid
93-7 A Case Study of Elastic Concrete Deck Behavior in a Four Panel Pre-stressed Girder Bridge Finite Element Analysis
93-8 Rehabilitation of Rutted Asphalt Pavements (Project IR-25-3(96)
93-9 Cold Hand Patching

93-10 Ice Detection and Highway Weather Information Systems
93-11 Comparison of 1992 Colorado Hot Mix Asphalt With Some European Specification
93-12 Curtain Drain
93-14 Type T Manhole(Experimental Feature)
93-15 SHRP Seasonal Monitoring Program in Delta
93-16 DOT Research Management Questionnaire Response Summary
93-17 In Service Evaluation of Highway Safety Devices
93-18 Courtesy Patrol Pilot Program
93-19 I 70 Silverthorne to Copper Mountain: A History of Use of European Testing Equipment
93-20 Analytical Simulation of Rockfall Prevention Fence Structures
93-21 Investigating Performance of Geosynthetic-reinforced Soil Walls
93-22 Influence of Testing Variables on the Results from the Hamburg Wheel-Tracking Device
93-23 Determining Optimum Asphalt Content with the Texas Gyratory Compactor

94-1 Comparison of the Hamburg Wheel-Tracking Device and the Environmental Conditioning System to Pavements of Known Stripping Performance
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94-2 Demonstration of a Volumetric Acceptance Program for Hot Mix Asphalt in Colorado
2-94 The Deep Patch Technique for Landslide Repair
94-3 Comparison of Test Results from Laboratory and Field Compacted Samples
3-94 Independent Facing Panels for Mechanically Stabilized Earth Walls
94-4 Alternative Deicing Chemicals Research
94-5 Large Stone Hot Mix Asphalt Pavements
94-6 Implementation of a Fine Aggregate Angularity Test
94-7 Influence of Refining Processes and Crude Oil Sources Used in Colorado on Results from the Hamburg Wheel-Tracking Device
94-8 A Case Study of Concrete Deck Behavior in a Four-Span Prestressed Girder Bridge: Correlation of Field Test Numerical Results
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94-10 Denver Metropolitan Area Asphalt Pavement Mix Design Recommendation
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94-14 Preliminary Procedure to Predict Bridge Scour in Bedrock (Interim Report)

95-1 SMA (Stone Matrix Asphalt) Flexible Pavement
95-2 PCCP Texturing Methods
95-3 Keyway Curb (Construction Report)
95-4 EPS, Flow Fill and Structure Fill for Bridge Abutment Backfill
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95-6 Reference Energy Mean Emission Levels for Noise Prediction in Colorado
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95-14 A Documentation of Hot Mix Asphalt Overlays on I 25 in 1994
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95-17 Avalanche Hazard Index for Colorado Highways
95-18 Widened Slab Study

96-1 Long-Term Performance Tests of Soil-Geosynthetic Composites
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96-11 Determining the Degree of Aggregate Degradation After Using the NCAT Asphalt Content Oven
96-12 Evaluation of Rumble Treatments on Asphalt Shoulders

97-1 Avalanche Forecasting Methods, Highway 550
97-2 Ground Access Assessment of North American Airport Locations
97-3 Special Polymer Modified Asphalt Cement (Final Report)
97-4 Avalanche Detection Using Atmospherical Infrasound
97-5 Keyway Curb (Final Report)

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